MODERN PLASTICS

March 1957

National S.P.I. Plastics Conference
and
Pacific Coast Plastics Exposition
Los Angeles, March 18-19-20-21
Program and exhibitors—*Opp. Page 1*

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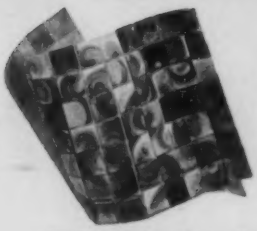

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As in these mosaics, which multiply small squares into a large beauty and economy, CATALIN STYRENE—in all its uses—exemplifies arithmetic at work. It *subtracts* from costs . . . it *adds* to molding capability . . . it *multiplies,* through product success, the opportunity for manufacturers to profit.

* Mastro Plastics Corp., N. Y. 62, N. Y., molders of TRI-BOND MOSAICS

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Another new development using

MODERN PLASTICS*

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BOLTA'S new Quilted Foam shows what can be done to influence customers with versatile Geon polyvinyl materials.

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Geon polyvinyl materials are available in literally hundreds of types, as resins, compounds, latices, polyblends, to perfectly match the requirements of thousands of products. These range from flexible upholstery to rigid piping and ductwork, from window gasketing to coatings for steel, paper, or textiles.

In your applications, selection of Geon polyvinyl materials is the right start to a quality product. For information write Dept. DS-3, B. F. Goodrich Chemical Company, 3135 Euclid Avenue, Cleveland 15, Ohio. Cable address: Goodchemco. In Canada: Kitchener, Ontario.

Vinyl foam made from Geon resin is a flexible, open-cell structure that has up to three times the tear resistance of other foam materials. It is easily heat-sealed to the vinyl surface by automatic equipment. Bolta's vinyl foam and Quilted Foam are distributed by General Foam Corporation, New York.

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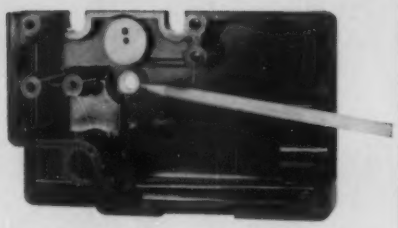

A unique phenolic part with a nylon bearing insert helps the Servel "Ice-Maker" make ice in a new way and in a new shape.

Combined molding of thermoplastic and thermoset materials helps assure trouble-free operation

If your next refrigerator is a Servel Icemagic, you'll find it solves the problems of ice-tray handling. It *eliminates* the tray—makes tumbler-round ice "cubes" automatically.

Part of the story behind this revolutionary development is a unique plastic part. It's made of phenolic—mostly, that is. However a small nylon bearing has been molded into the phenolic part. As a result, this self-lubricating nylon bearing allows the ice ejector arm to rotate freely . . . eliminates oil and any chance of ice contamination.

This was quite a trick . . . combining nylon and a phenolic. One's a thermoplastic; the other's a thermosetting plastic that requires molding heat that will normally soften a thermoplastic. To make a molding from both materials was like putting oil and water together. However, by selecting special formulations, and molding under mechanically contrived temperatures and conditions, Chicago Molded *did* the trick.

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Editorial

The Conference and Show

The entire content of the general feature section of this issue of MODERN PLASTICS, plus parts of other sections, are devoted to significant plastics developments in the Pacific Coast and Mountain states.

This was done, first, to point up the 1957 National Plastics Conference, to be held for the first time on the Coast, at the Biltmore Hotel, Los Angeles, Calif., March 18-21; second, to draw attention to the first Pacific Coast Plastics Exposition, to be staged simultaneously at the Shrine Exposition Hall in Los Angeles.

The decision of the directors of S.P.I. to hold this year's conference in Los Angeles was based on the awareness a) that the plastics industries on the coast are developing along specialized lines tributary to the aircraft, missile, electronics, agricultural, and construction fields, and b) that techniques pioneered for plastics use in these fields may significantly contribute to applications in other industries in other parts of the nation.

In addition to the specialized nature of plastics development on the coast is the over-all expansion of the industry in that area. As the populations and the economies of the states concerned are growing at a faster pace than those of the rest of the country, uses of plastics and requirements for plastics are expanding in like proportion.

All these factors are reflected in the content of this issue as well as in the conference program printed in the folded insert found opposite page 1. The insert also contains a plan of the exposition hall and a list of the exhibitors with their booth numbers. Full information is offered on what each exhibitor will show and what representatives will be in attendance.

The lead article beginning on page 123 presents a general picture of the present status and growth potentials of the plastics industries in the eight far-western states. It is intended to serve as a background for the detailed features on significant developments in succeeding pages.

If this conference and show are successful—and there is every indication that they will be—perhaps a new pattern may be set. Surely the spirit and enthusiasm of westerners in plastics should encourage the staging of more such events on the coast.

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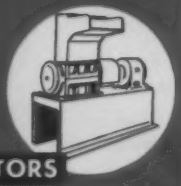

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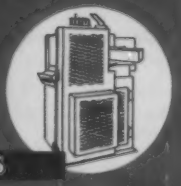

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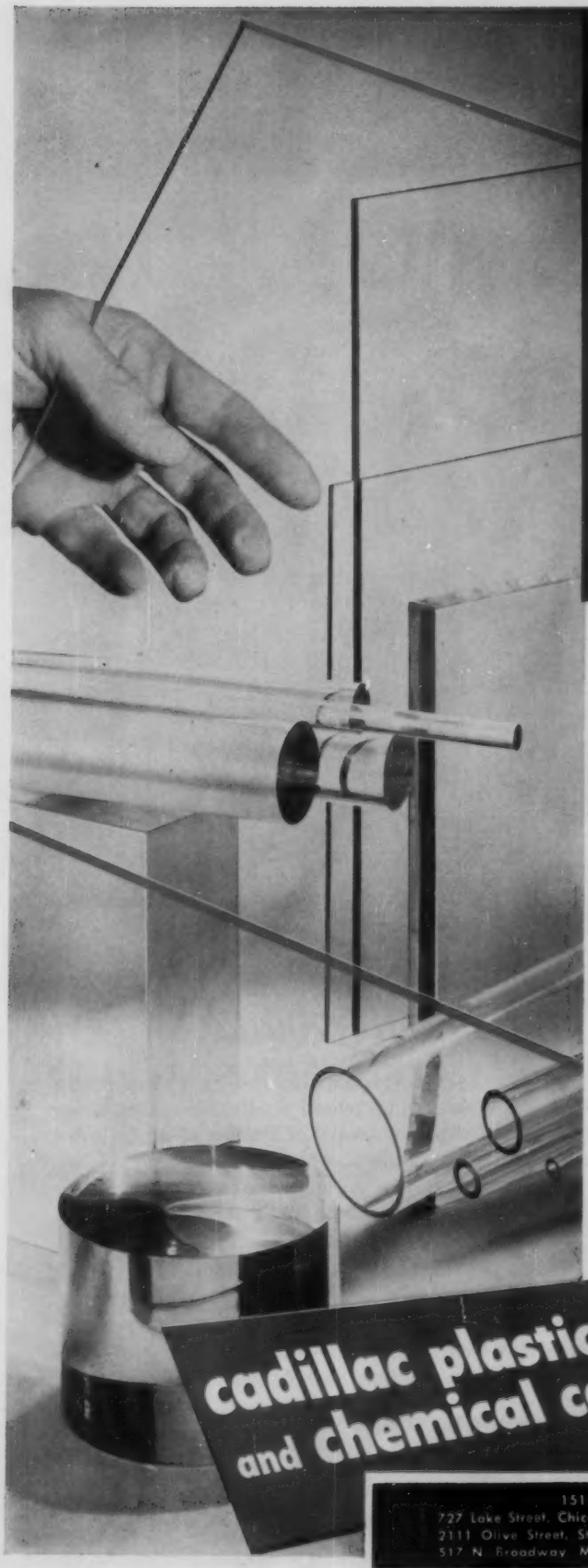

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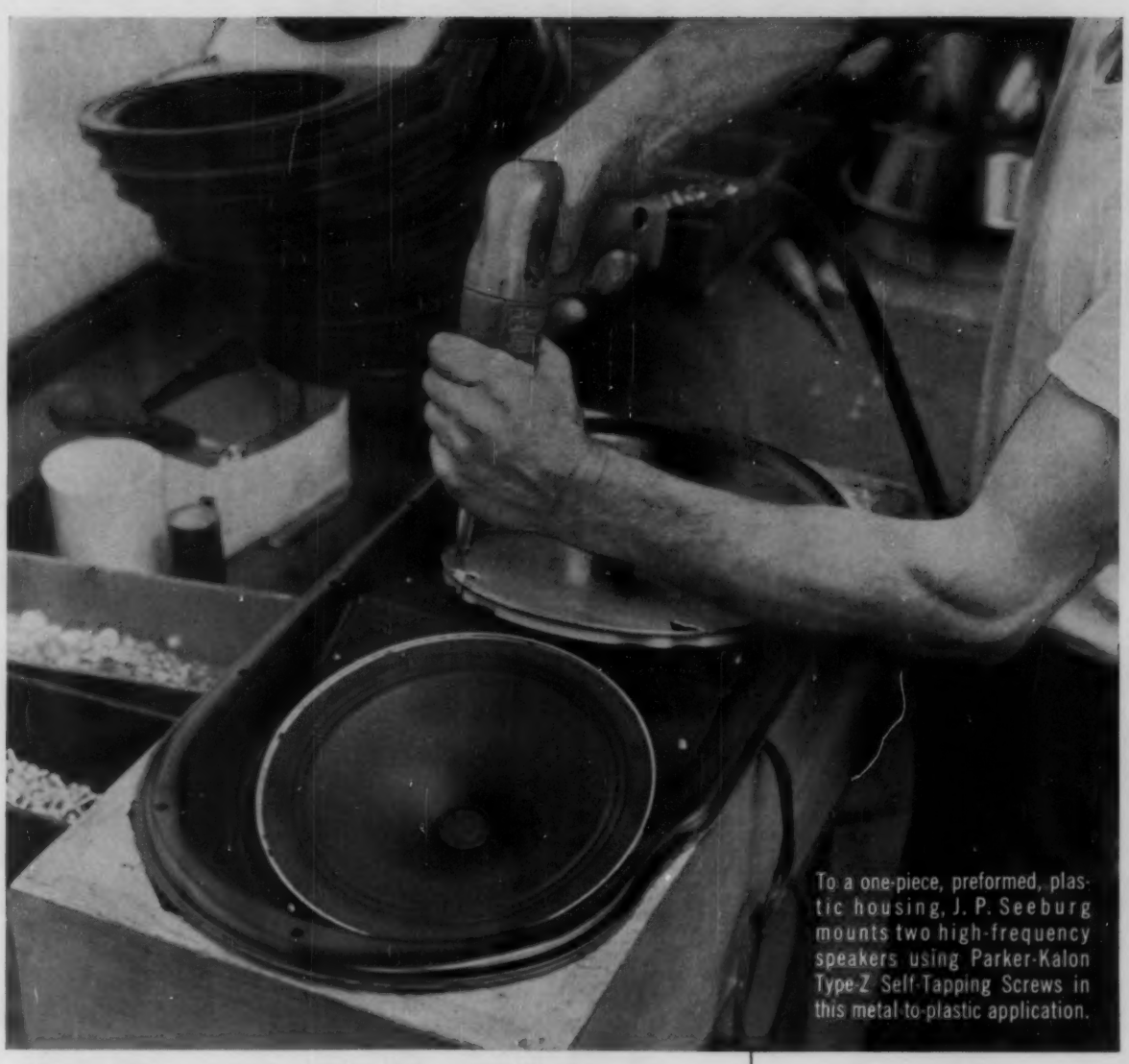

To a one-piece, preformed, plastic housing, J. P. Seeburg mounts two high-frequency speakers using Parker-Kalon Type-Z Self-Tapping Screws in this metal-to-plastic application.

for plastic speaker housings, Seeburg specifies **P-K**® fasteners

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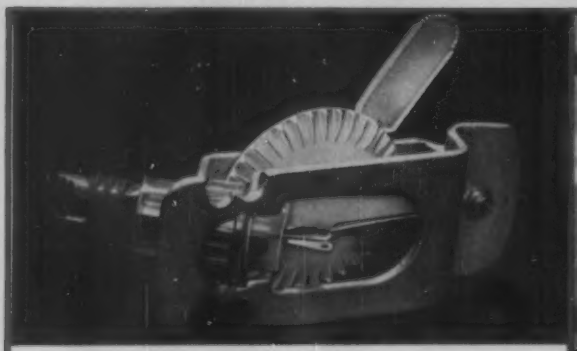
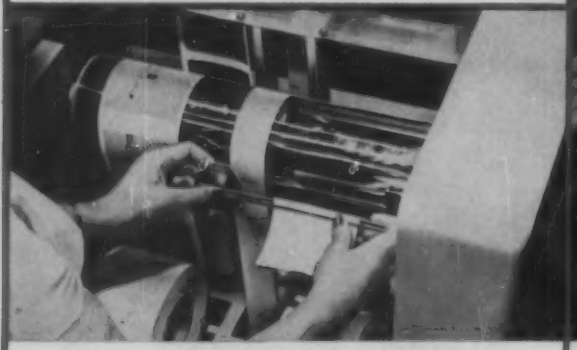
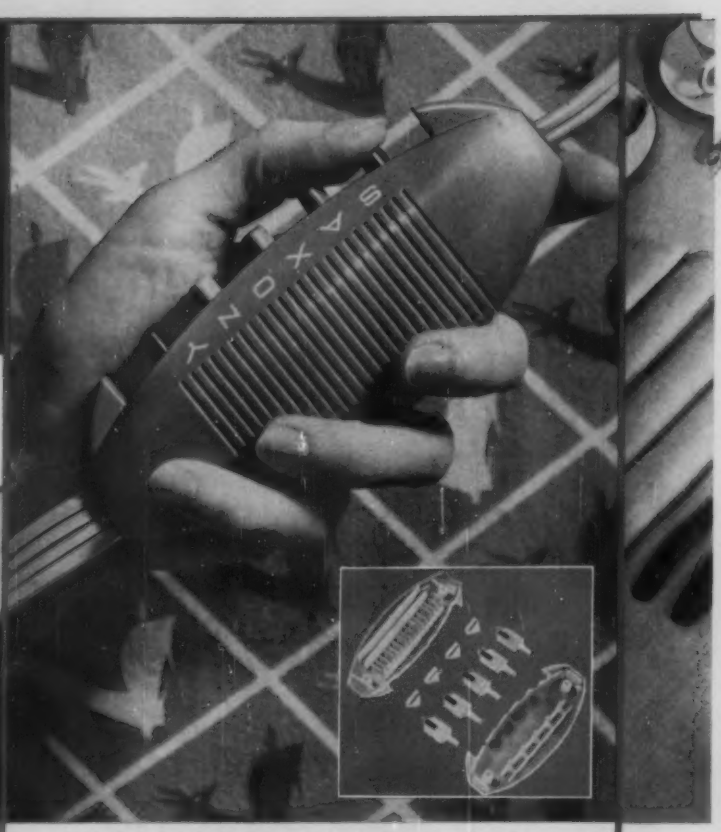
7 more examples showing how makes new products



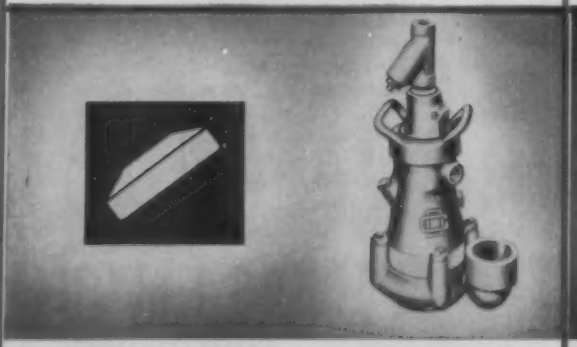
THIS PHONOGRAPH CARTRIDGE HOLDER made of ZYTEL is molded in an intricate shape. The excellent dielectric properties and toughness of ZYTEL are important in this application because of the thin walls required. (Molded by Hughes Plastics, Inc., St. Joseph, Michigan, and John Mack & Son Molded Products, Inc., Chicago, Illinois, for Electro-Voice, Inc., Buchanan, Michigan.)



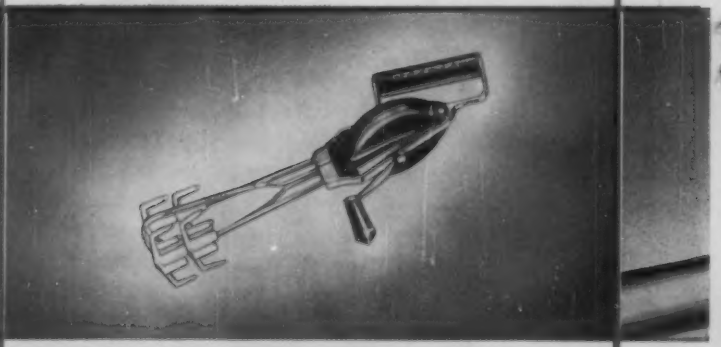
STRIP FOR THE BELTING of this photo-processing machine is unaffected by developing and cleaning solutions because it is made of ZYTEL. ZYTEL has high tensile strength and is resilient and flexible. (Belting supplied by Polymer Corporation of Pennsylvania, Reading, Pennsylvania.)



FOUR-TEMPERATURE SWITCH used for heating pad is molded of Du Pont ZYTEL nylon resin. The simple, modernistic exterior contrasts sharply with the intricate interior design. A five-year guarantee is issued with each switch—proof of the manufacturer's confidence in the strength of ZYTEL. Du Pont ZYTEL is very strong even in thin sections. (Switch components by Wilmington Plastics Company, Wilmington, Delaware, for Saxony Electronics, Inc., Wilmington, Delaware.)



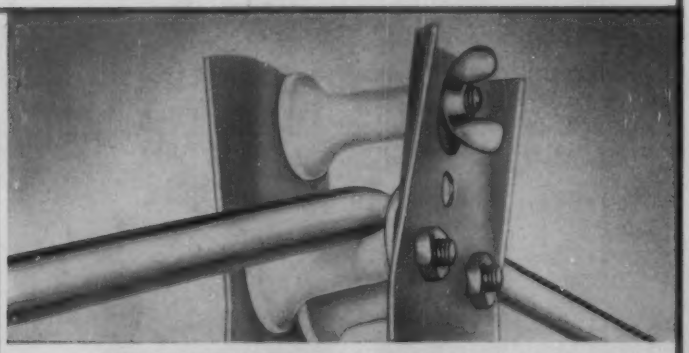
THIS PNEUMATIC SUMP PUMP, run by air pressure, contains four vanes of ZYTEL. Driven at high speeds, the vanes are resistant to wear. They are molded to extremely close tolerances for maximum pump efficiency. (Molded by Ingwersen Manufacturing Co., Inc., Denver, Colorado, for Gardner-Denver Company, Denver, Colorado.)



THE GEARS, BEARINGS AND BLADES of this mixer are made of ZYTEL because it is light in weight and resistant to heat, wear and corrosion. The Maynard Manufacturing Company of Glendale, California, expects these parts made of ZYTEL to outlast useful mixer life.

Du Pont ZYTEL® nylon resin possible . . . existing products better

"CONTRAST," A NEW ALL-PURPOSE TABLEWARE featuring luxury styling, blends black ZYTEL with sterling silver. The handles of ZYTEL nylon resin will not warp, fade, stain or swell. They are unaffected by soapy water or high dishwasher temperatures. Perfect for quality consumer products, ZYTEL is warm to the touch, colorable, and has a rich, soft sheen. Where durability is important, ZYTEL serves best. (Manufactured by Lunt Silversmiths, Greenfield, Massachusetts.)



CABLE STRINGING BLOCK is equipped with spools of ZYTEL nylon resin. The spools are abrasion-resistant and tough and will not damage cables. They cannot corrode and are unaffected by adverse weather conditions. (Processed by Engineered Products, Inc., Kirkwood, Missouri, for D.H.S. Company, St. Louis, Missouri.)

• Du Pont ZYTEL offers versatile design possibilities because of its strength, its resistance to wear and its ability to be molded into accurate and complex shapes. Frequently an entire assembly of many parts can be replaced by a single multi-function part of ZYTEL.

Since it can be injection-molded, ZYTEL permits rapid mass production with consequent savings in production costs. Its lightness in weight means more parts per pound. ZYTEL is tough, resilient. Parts made of ZYTEL resist shock and vibration and operate more quietly. Bearings, cams and gears need little or no lubrication. Many uses of ZYTEL nylon resin are based on the fact that it is unaffected by temperatures up to 250°F. ZYTEL offers good electrical insulating properties, and is used to make a large number of electrical components, among which, to mention a few, are terminal blocks, insulating sleeves and washers, coil forms, electrical fittings, jacketings and casings.

This outstanding design material is unaffected by most common chemicals in home and industry, including lubricants and cleansing materials. Du Pont ZYTEL comes in a variety of colors and is also available in black and metallics.

For further information on the properties and applications of Du Pont ZYTEL nylon resin, clip and mail the coupon below.

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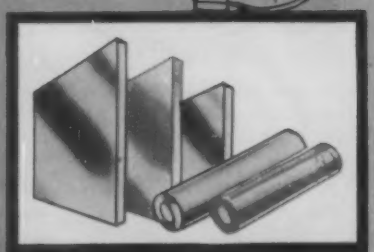

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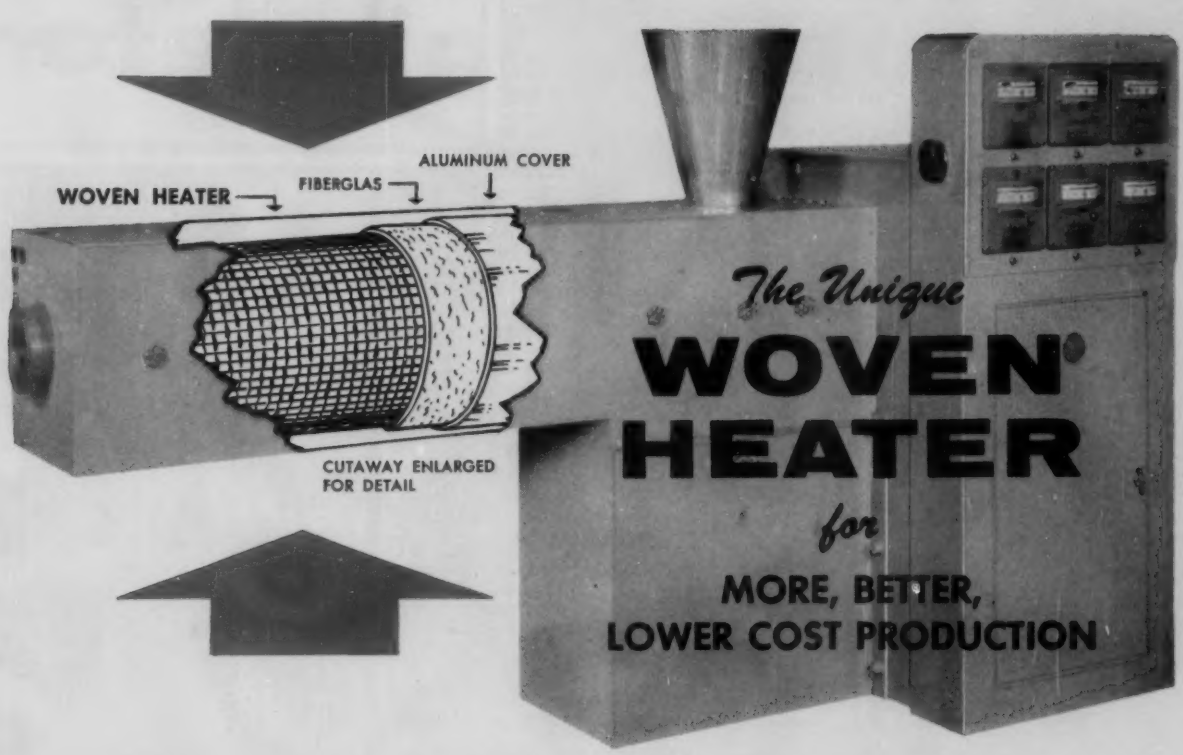

MORE EFFICIENT — Being flexible, MPM Woven Heaters conform more accurately with the surface of the cylinder or die to be heated, thereby assuring more uniform application of heat. The die heat of Woven Heaters is far more accurate since every square inch of the heater is effective. Warping, common to cast or "band type" heaters, is eliminated.

LOWER OPERATING COST — Tests indicate that MPM Woven Heaters operate on 50% or less of the wattage required by so called "band heaters" or more expensive calrod heaters cast into aluminum.

LONGER LIFE — Woven Heaters have a life up to *five times greater* than other types.

LOWER REPLACEMENT COSTS — The replacement cost of a Woven Heater is lower. It is far lighter than other types and, being flexible, can be shipped by parcel post to any point in the world.

MORE ACCURATE TEMPERATURE CONTROL — With reactor type controls, far greater accuracy of temperature control can be obtained with MPM Woven Heaters.

MOISTURE PROOF — MPM Woven Heaters are moisture proof and their efficiency unaffected by the condensation ordinarily present at the hopper.

BETTER RESULTS — More accurate, better tolerances and quality of the extruded product can be expected at no increase in cost.

Thirty three of the country's foremost resin manufacturers acknowledge MPM's superiority and use MPM extruders for extruding experimental thermoplastic compounds and for development work in behalf of their customers. MPM equipment is also in current use in *forty foreign countries.*

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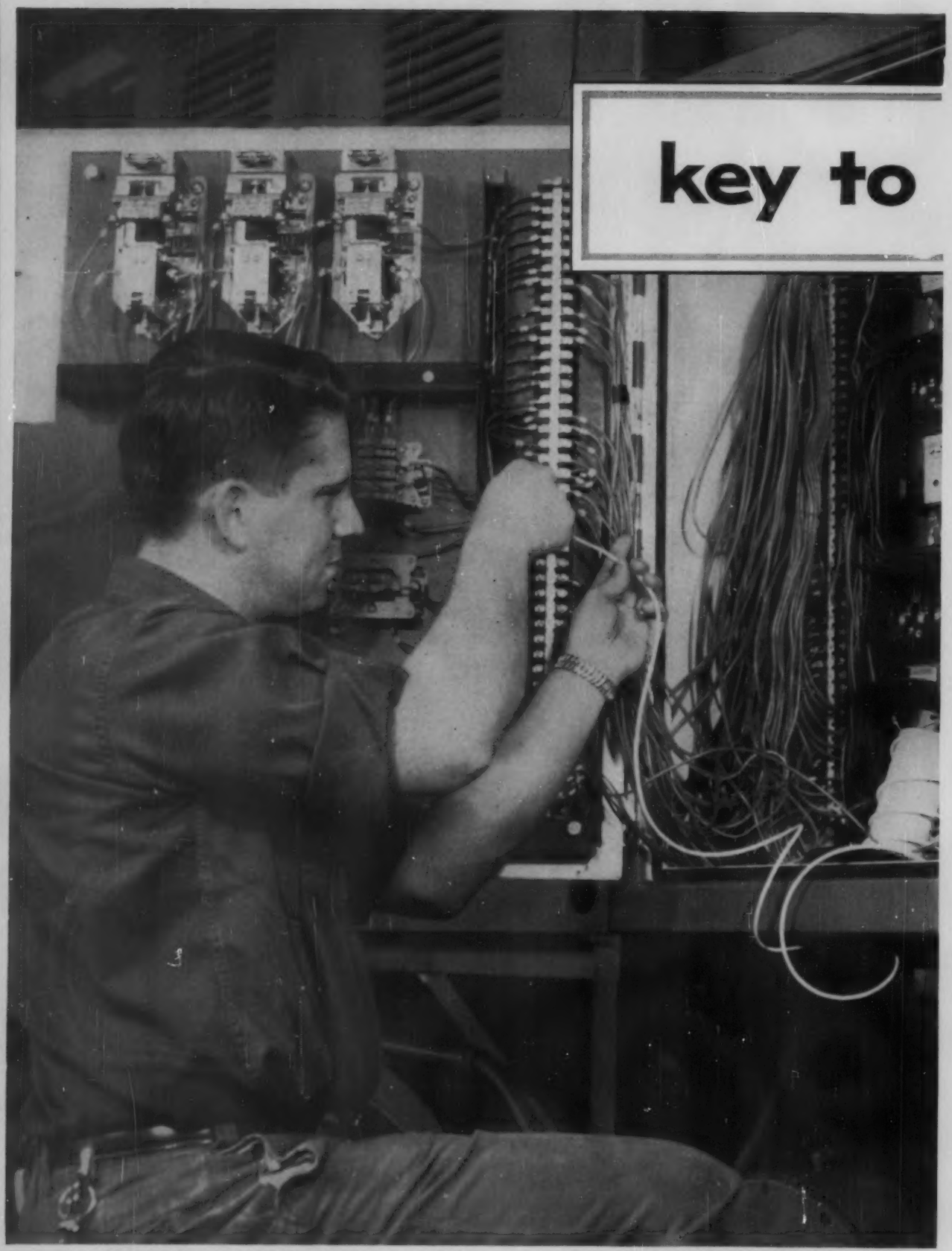

Photo courtesy Royal Electric Corp., Pawtucket, R. I., subsidiary of International Telephone & Telegraph Corp., and Pratt & Whitney Aircraft Division, United Aircraft Corporation, E. Hartford, Conn.

mastering a maze

Colored covers are the key to the mysterious maze of wire found in automatic machine tools. By following a simple color code, an electrician swiftly and surely solves any circuit.

Not so simple, however, is finding the *right* machine tool wire covering. Besides the need for bright, permanent colors, such jacketing must be extremely thin and highly insulative. It must also be tough, flexible, and resistant to oil, fumes and age.

After careful testing, a leading wire supplier finally chose a PLIOVIC EDB90V compound for the job. The reasons for choosing PLIOVIC EDB90V were as follows: 1. Its uniform quality 2. Its interchangeability with other UL approved resins 3. Its superior insulation resistance and dielectric strength 4. Its excellent physical properties.

Moreover, being a dry-blending resin, PLIOVIC EDB90V permitted substantial economies in processing. It readily formed a sandy, free-flowing mix with minimum dusting, and displayed excellent extrusion properties. Dry blending also resulted in better end properties through a shorter heat history.

Why not learn more about dry-blending, Underwriters' Laboratories approved PLIOVIC EDB90V? Find out also about the other interesting members of the PLIOVIC family. You can do both simply by writing for details plus the latest *Tech Book Bulletins* to: Goodyear, Chemical Division, Akron 16, Ohio.

Plastics Department

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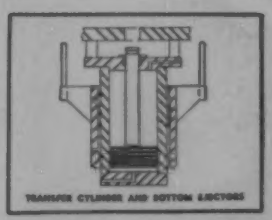
Automatic compression to transfer molding by turning a knob! - ALL ON ONE PRESS



TRANSFER CYLINDER AND BOTTOM EJECTORS

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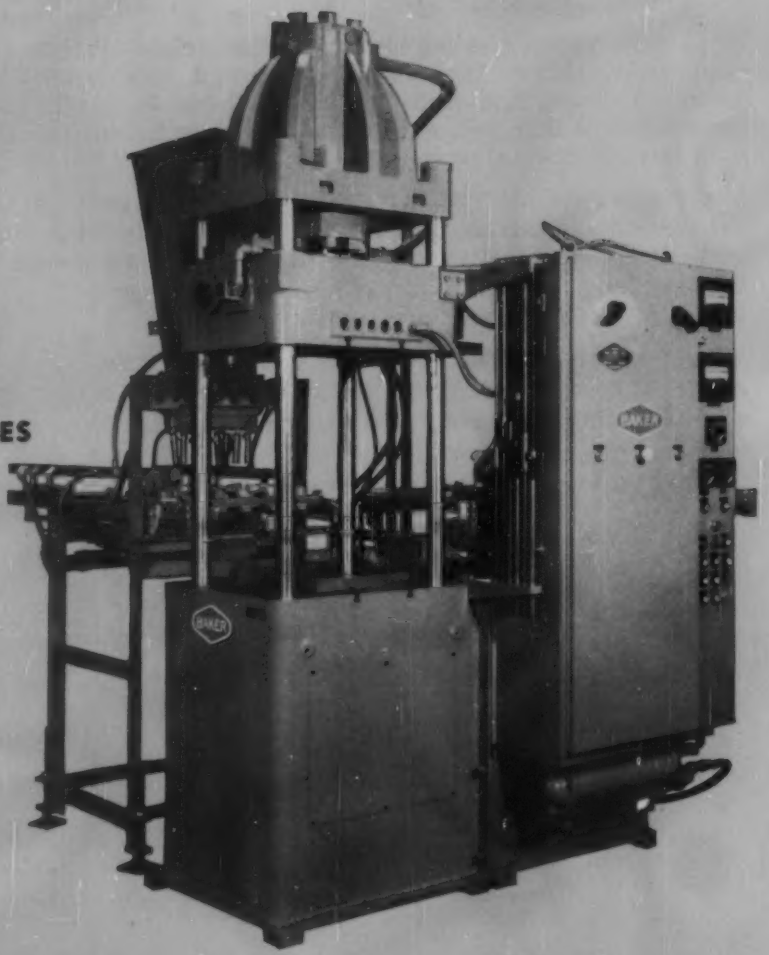
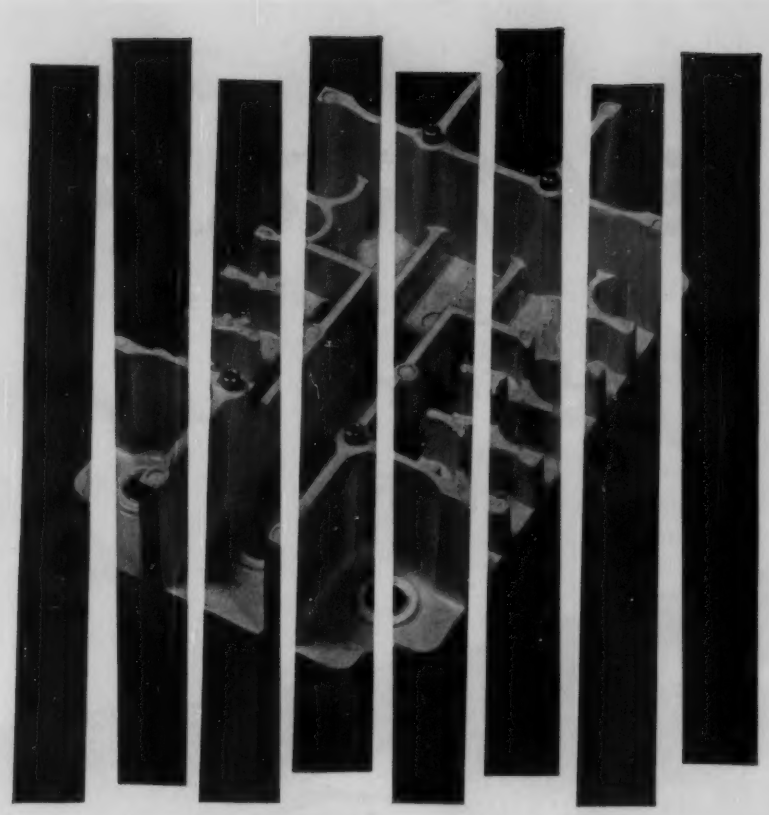
MOLDING MACHINES





take another look... at plastic molding deliveries

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It meets a rather tight set of dimensional, physical, and electrical specifications, and it was shipped on a schedule that made the customer as happy as the performance of the part itself.

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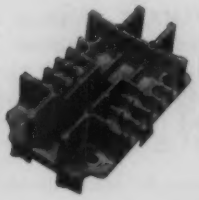

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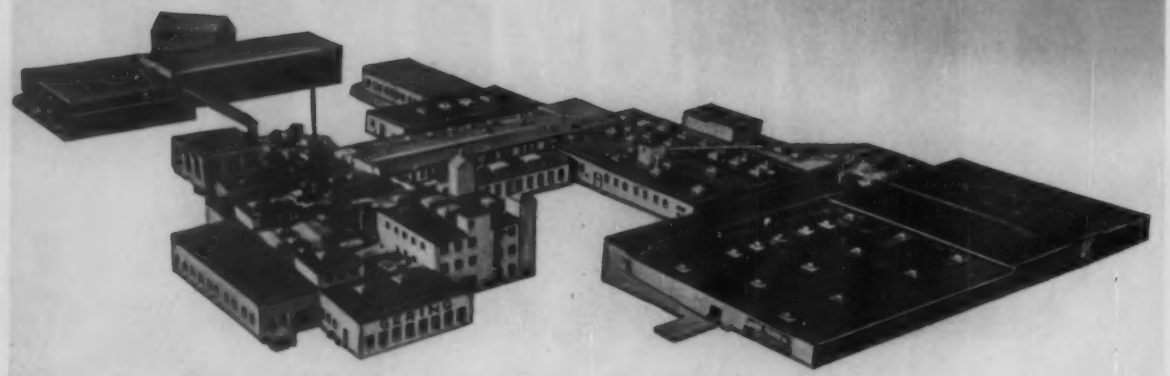

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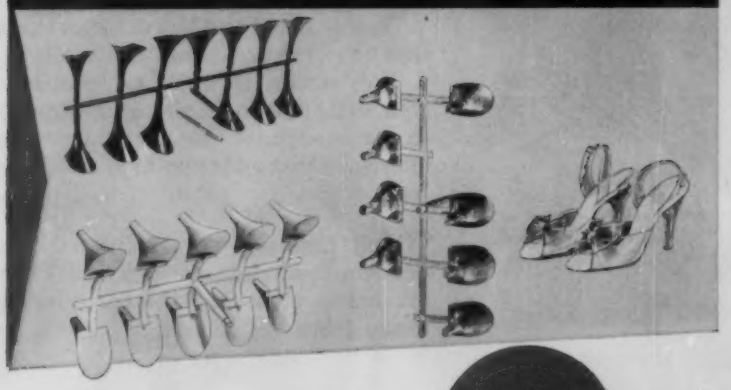

Getting the proof etc., etc., is an old Missouri custom and performance is certainly the final answer. That's why this case study—the story of a new process replacing a time-honored material like wood, is news in itself. And H-P-M plastics injection molding machines helped make this transition possible. This company has four H-P-M 12 oz. machines in production which, at 45 cycles per hour, have been molding "shots" weighing 21 oz. and over. They have three more ready to install and **three more on order.** It takes performance to instill this kind of confidence and the red hot, H-P-M "12" is winning this kind of support. This progressive company is molding 450 shoe heels per hour with each machine, enough for 225 pairs of shoes. Extra large plasticizing capacity, fast cycle speeds, plenty of "performance" capacity to stand up to day-in, day-out production needs are only a few of the H-P-M "12" outstanding characteristics. Got a plastic problem? Call H-P-M with the most complete line of plastic molding equipment. Write today for the complete story.

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And who's a molding expert? Well, we've been feeding our families for some 35 years now, so we must know something about the business. The odds are strong that somewhere along the line we've met up with—and licked—problems similar to yours. We've worked with just about every plastic material in the books—plus even a few the books don't mention. And we're well versed in every molding technique.

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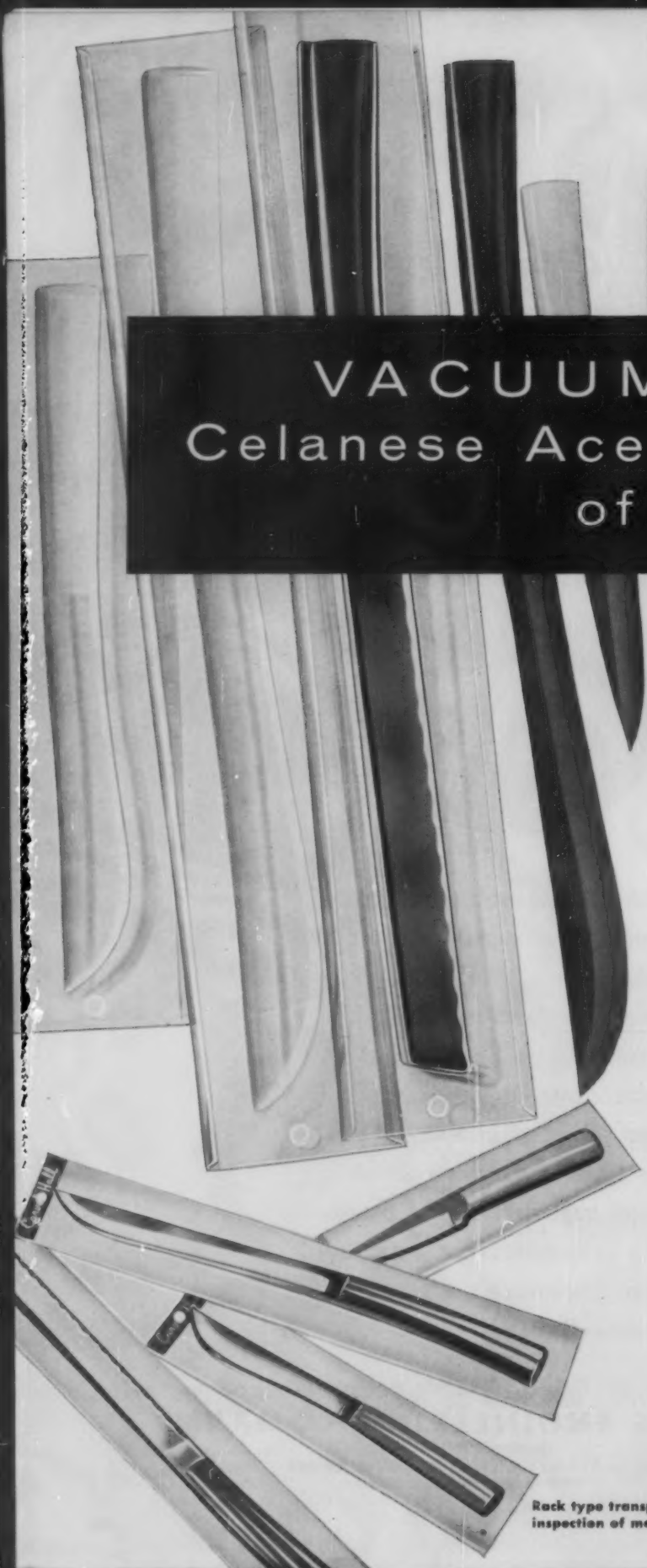

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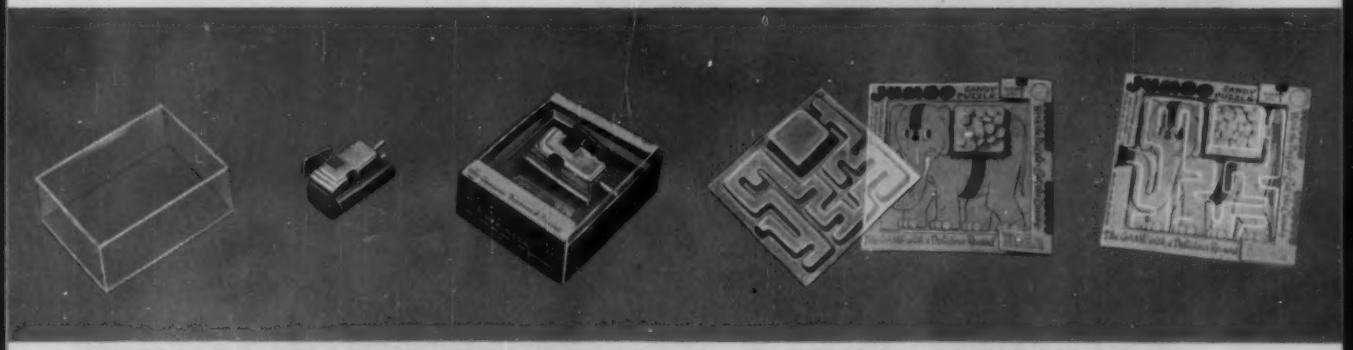
Rack type transparent container for Carvel Hall. Slide out back permits inspection of merchandise. Container by Plaxall, Inc., Long Island City, N. Y.

Transparent candy box for Charm Candy Co., Bloomfield, N. J.

Blister Pack by Vakipak, New Haven, Conn., for Car Mac Key Chain.

...PRESSURE-FORMED takes the shape for added selling impact



Transparent Sleeve by Syracuse Plastic Molders, Syracuse, N. Y., for General Electric Hi-Fi Cartridge.

Puzzle-type blister pack by Par Beverage Corp., Cincinnati 10, Ohio, for Candy Maze.

Blister combination packaging by Minnesota Mining and Manufacturing Company, St. Paul, Minn., for "Scotch" brand cellophane tape.

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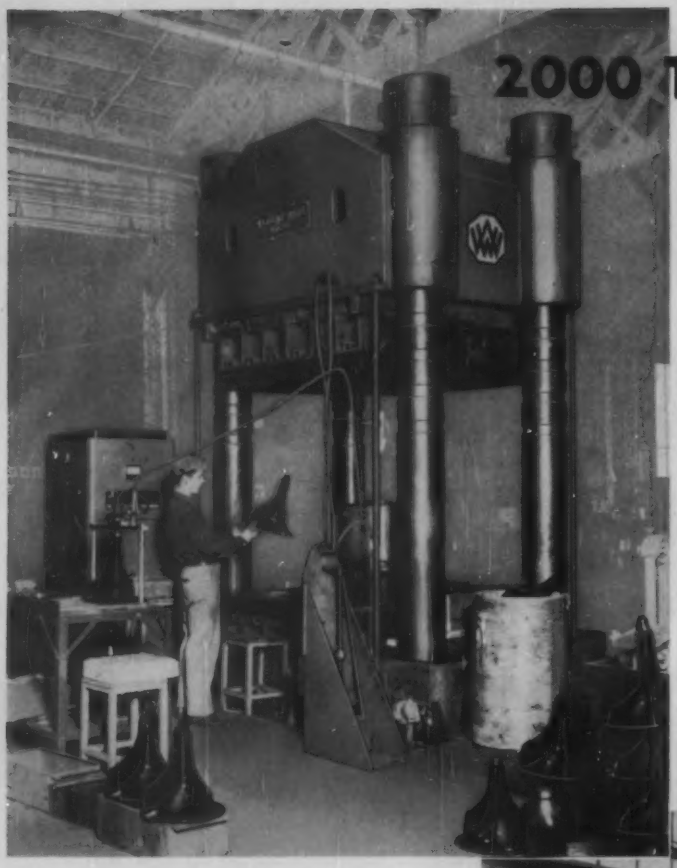

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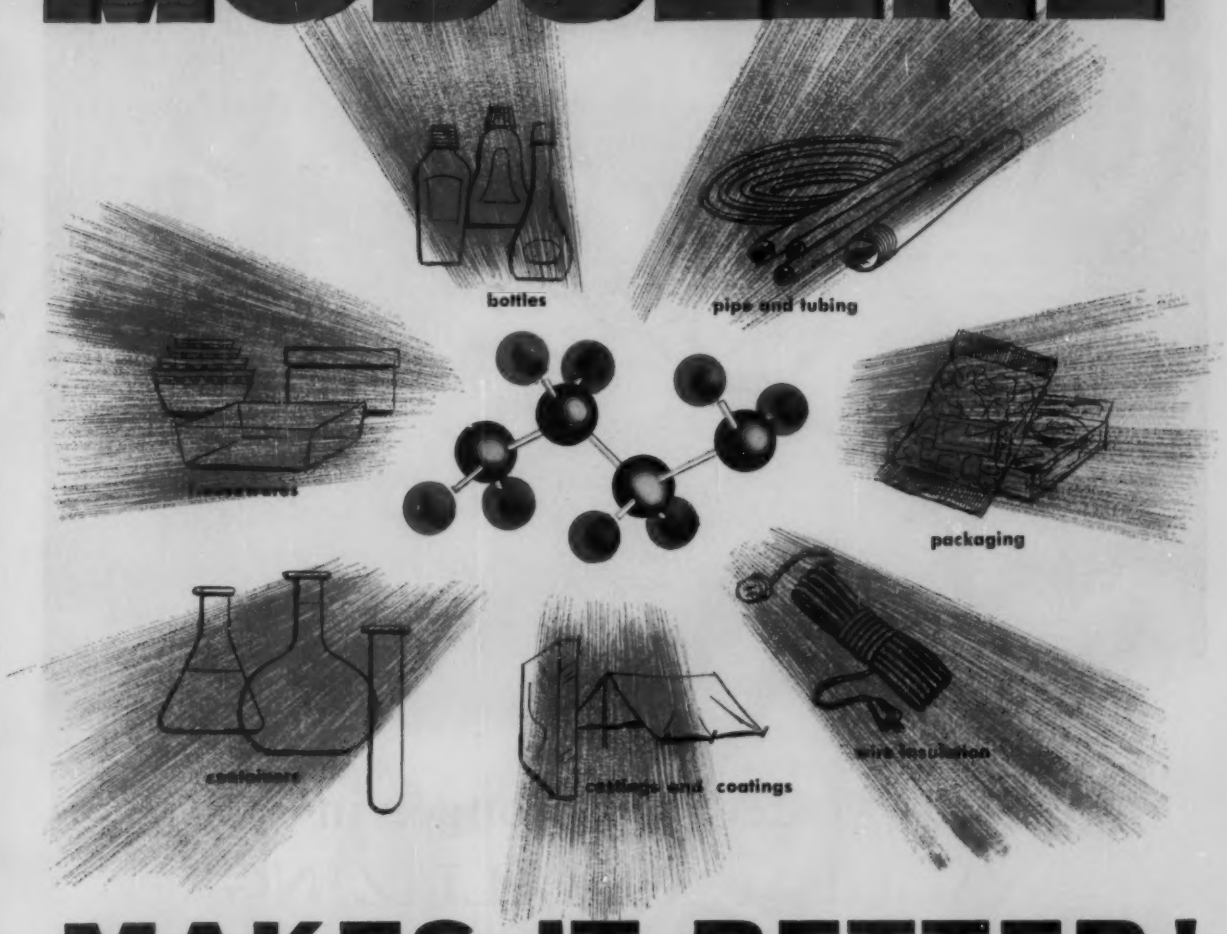

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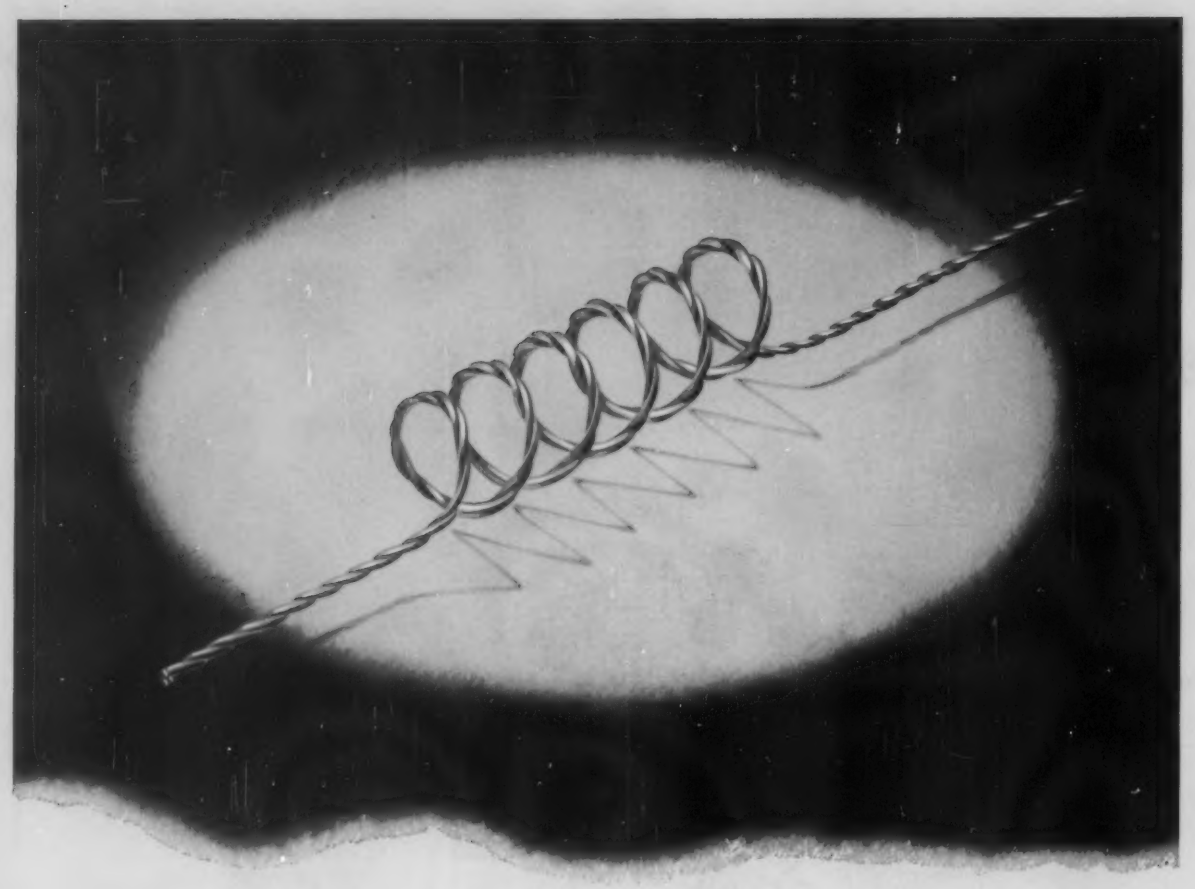

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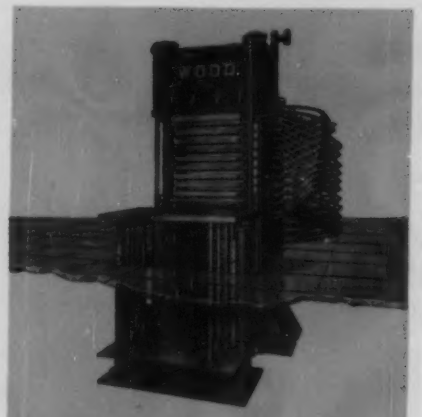

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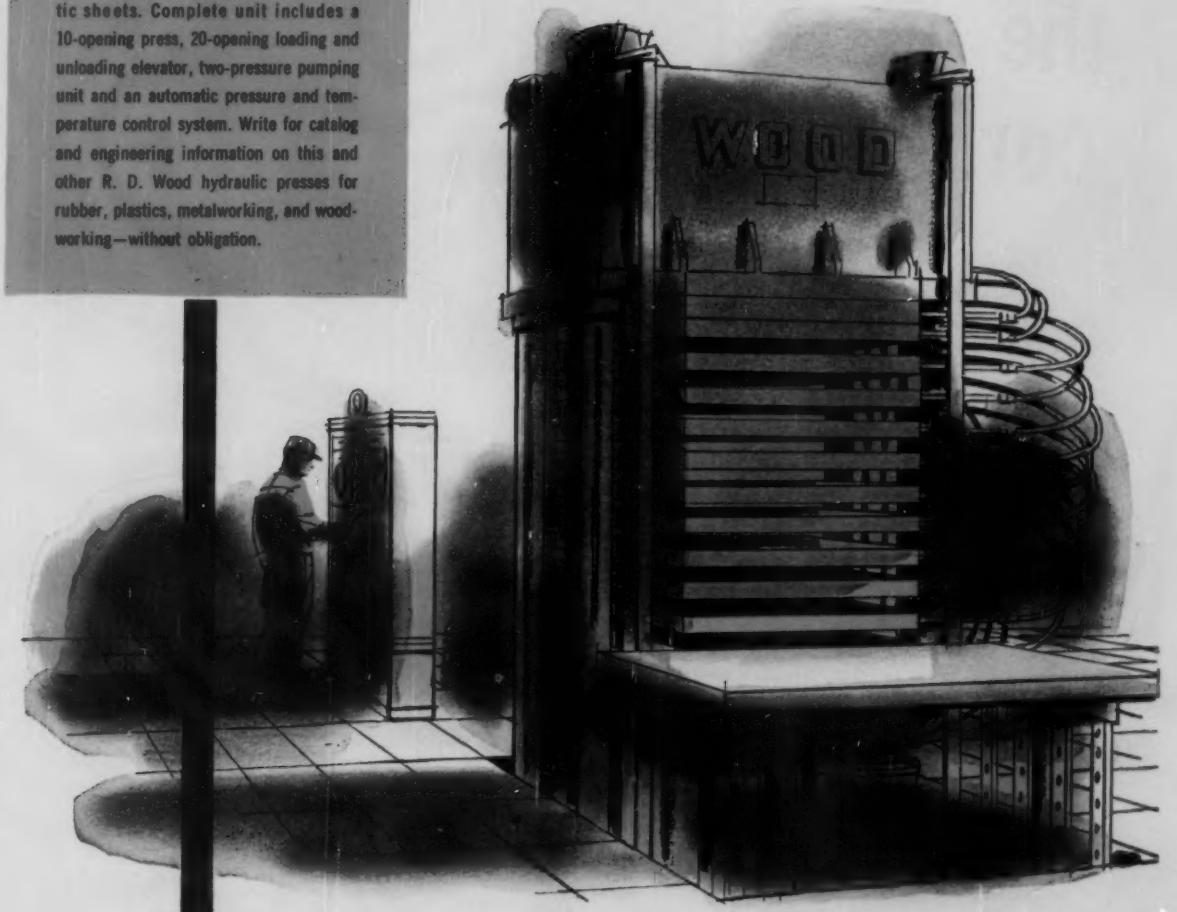

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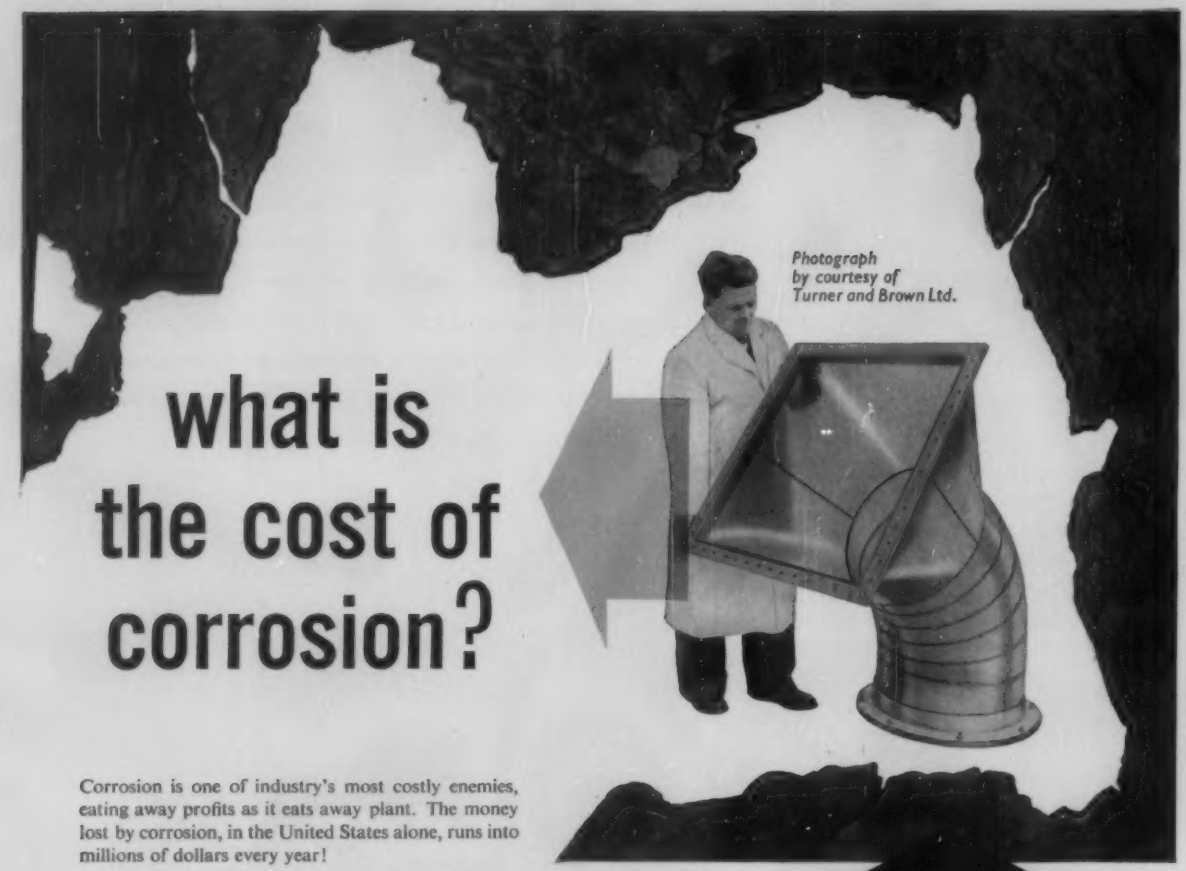

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what is the cost of corrosion?

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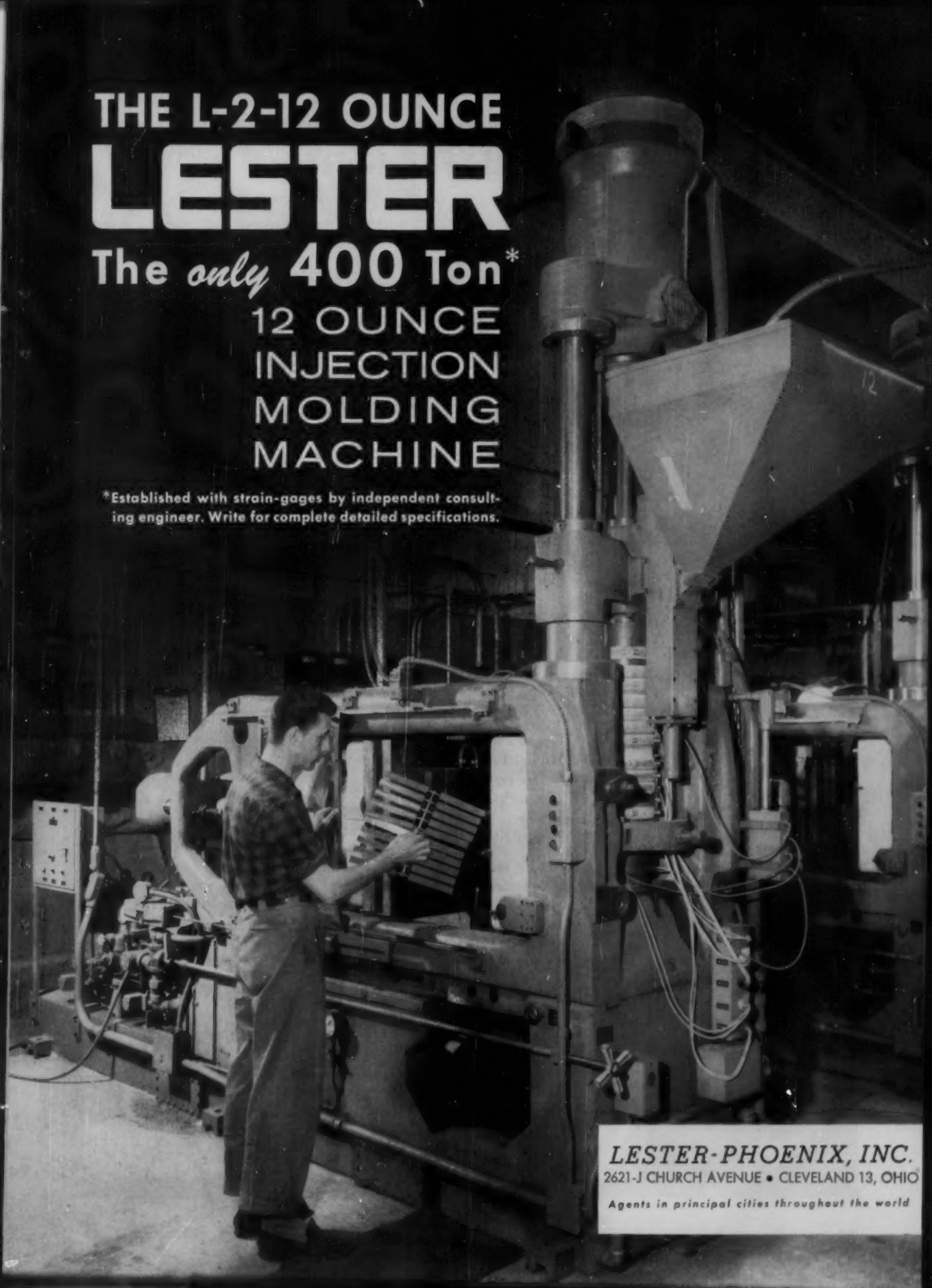

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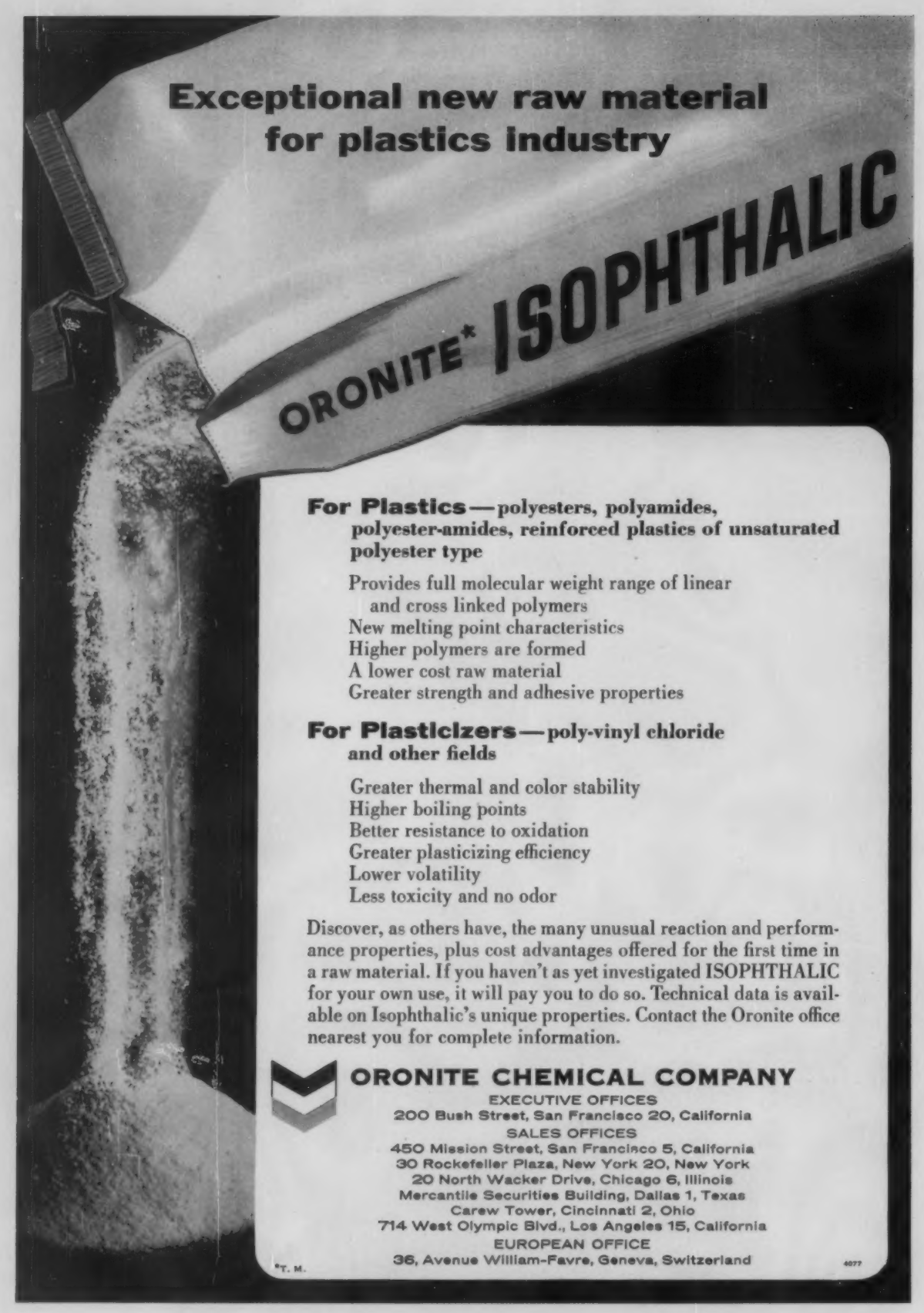

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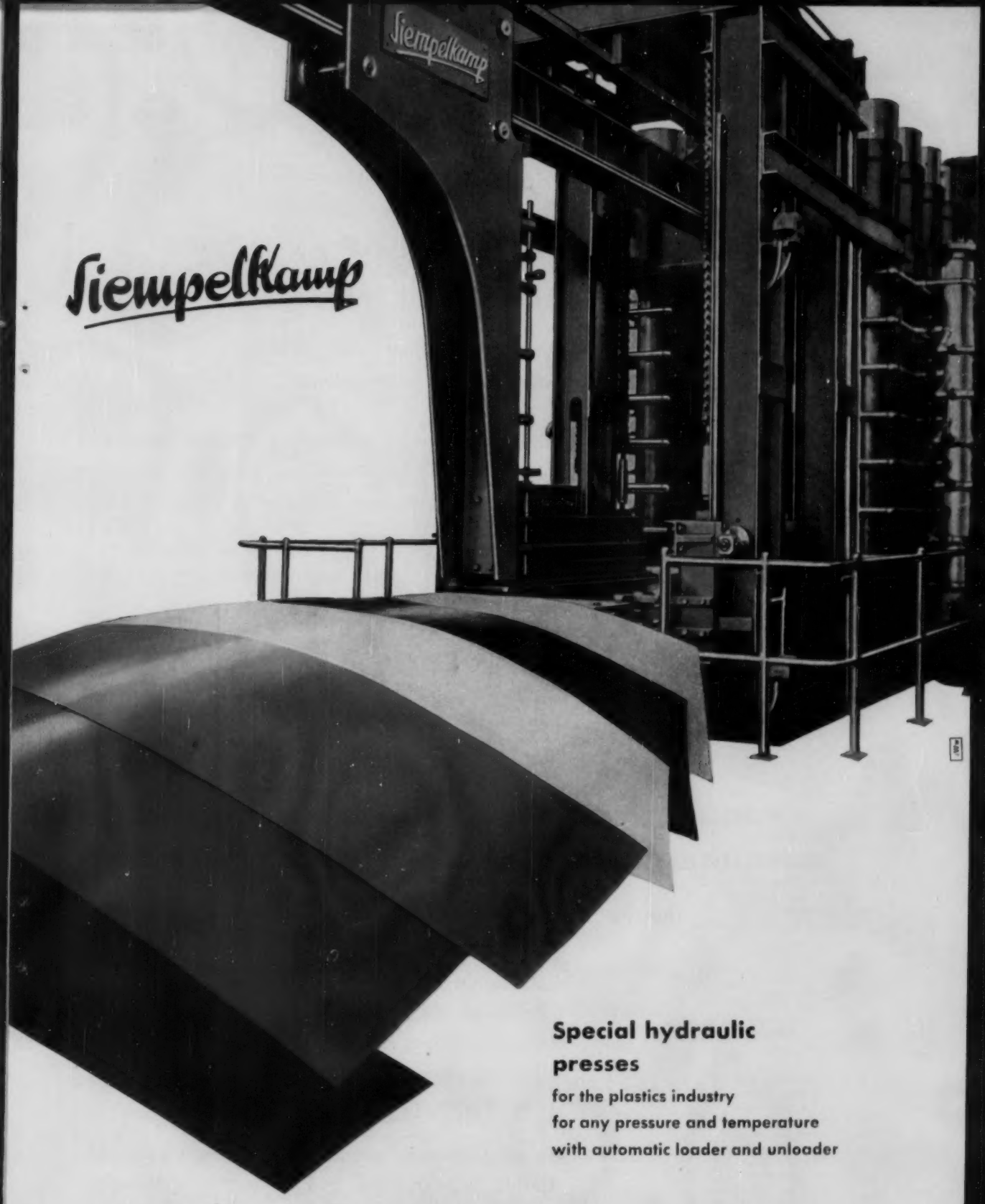

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TECHNICAL BULLETIN

CLAREMONT
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DIVISION

date: MAR. 1, 1957

subject.

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Surfaces of *filled* reinforced polyesters are definitely better than those that aren't filled. Glass fibers are hidden. Deep cracks in resin rich areas are eliminated.

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Unfilled resin tends to flow from between closed match dies. You waste resin. Filled resin, because of its higher viscosity, stays within the mold's confines. Using the proper DIAMOND filler, you can control the viscosity and give the resin a body most suitable for the operations involved.

Decreased shrinkage

Fillers greatly reduce the shrinkage occurring during polymerization.

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After immersion in water for seven days, filled polyesters show less loss in physical properties than unfilled ones do.

More even cooling rate

Polyester resin cools five to six times faster than glass fibers. This makes the fiber pull away from the resin, particularly at the surface. You get a surface that's difficult to paint. A precipitated calcium carbonate helps the resin mix and the glass fibers cool at a more even rate. The surface is smoother, easier to paint.

These improved properties reduce rejects and eliminate "touching up."

What fillers? DIAMOND suggests these four:

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Kalite®—Particle size: about 1 micron. Oil absorption 28-32 cc per 100 grams. Recommended for draw work.

Suspenso®—Particle size: 1 to 5 microns. White. Uncoated. Oil absorption 20-22 cc per 100 grams. Use in applications where pot life is critical. Eliminates crazing in resin rich areas.

Multifex® MM—Particle size: .05-.06 micron. Uncoated. Gives reinforced plastic a smooth white, nonporous finish. Requires less extra work after molding. Little buffing required.

*Your nearby DIAMOND sales representative can show you money-saving formulas and detailed cost comparisons. Or ask for Bulletin No. 8. Write DIAMOND ALKALI COMPANY, 300 Union Commerce Building, Cleveland 14, Ohio.

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Diamond Chemicals

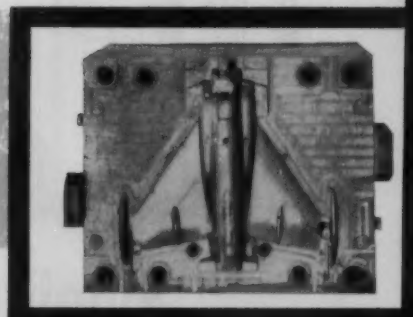
Cascade

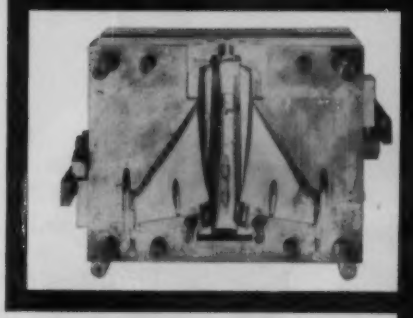
pre-hardened plastic mold steel

. . . soars to new heights

IRVIN R. ATHEARN CO., Los Angeles, Calif. produces these precision-made flying model airplanes for the toy industry.

L. D. PLASTICS TOOL & DIE CO., South Gate, Calif. made these close tolerance Cascade molds to produce the model airplanes.





Here was the problem . . .

Uniform flight of the model airplane demanded that exceptionally close tolerances on all wall thicknesses be held to insure even weight distribution in the finished toy. This required a mold steel with outstanding finishability characteristics as well as a steel that would be free from size change and distortion during heat treatment. Also, because of the complexities of the mold, the steel had to be readily machinable and possess good welding characteristics.

Cascade more than met the requirements . . .

The outstanding machinability and polishability of Cascade resulted in finer machined surfaces and higher finishes . . . important in the production of the close tolerance model planes. The excellent welding characteristics of Cascade was another outstanding feature because of the extensive welding required on this complex mold. In addition, heat treating risks were completely eliminated as Cascade is supplied uniformly prehardened at a hardness level of Rockwell C 34-36.

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P.615/O/A

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"ROLL-RACK" BABY FOOD DISPENSER

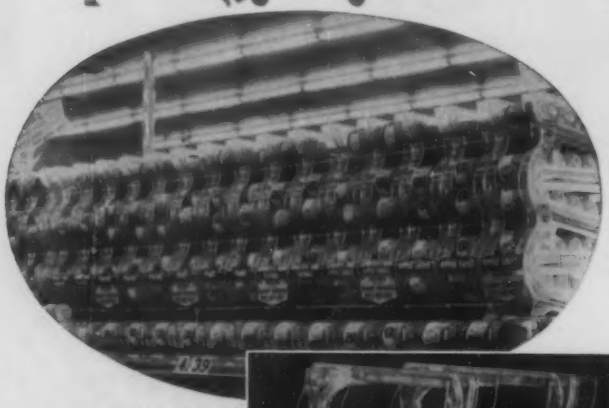
custom-molded by . . . ERIE plastics

The "Roll-Rack" combination display unit and dispenser is a most ingenious device for the purpose. It provides quick, easy self-service to the customer and automatic "first-in first-out" stock movement for the dealer.

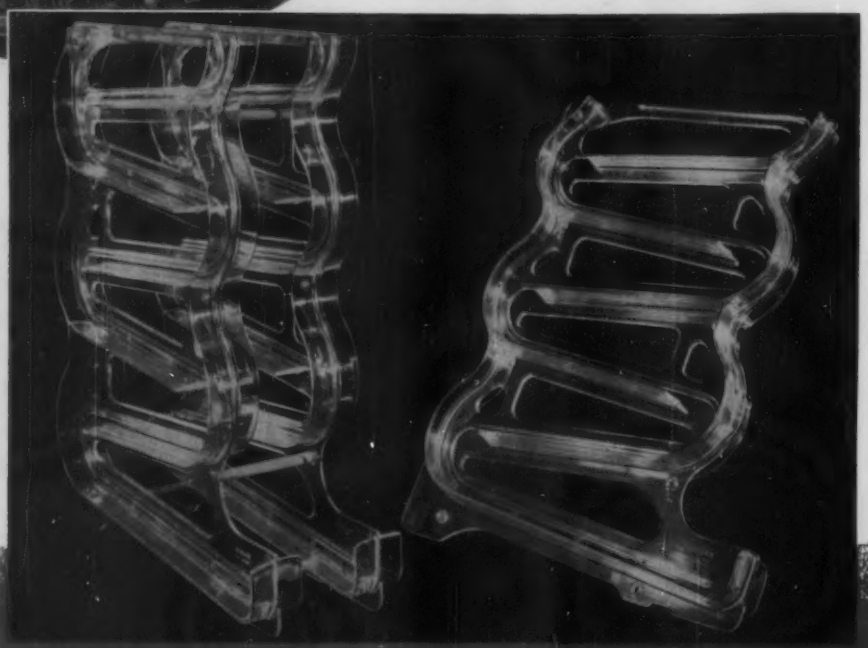
The plastic item is the main panel. The "track" is duplicated on both sides of the panel . . . thus a single panel serves as the reverse sides of adjoining compartments. Any number of panels may be secured together, depending on the space to be used for the display.

This patented dispenser, designed by the Roll Rack Company, Youngstown, Ohio, is molded from crystal general purpose polystyrene in a two cavity mold and 60 ounce molding machine equipped with a pre-plasticizing unit. Economy and ease of molding were factors in the choice of material. Clear plastic was chosen for high visibility through the sides of the units.

The "Roll-Rack" for Baby Food is a Heinz Baby Food exclusive and is another intricate custom molding job by ERIE Plastics. ERIE Sales Engineering Department is available to help you solve your custom molded plastics problems.



Above: Heinz Baby Food display in "Roll-Rack" Dispensers in a large Super Market



Right: Sections of the "Roll-Rack"

ERIE plastics

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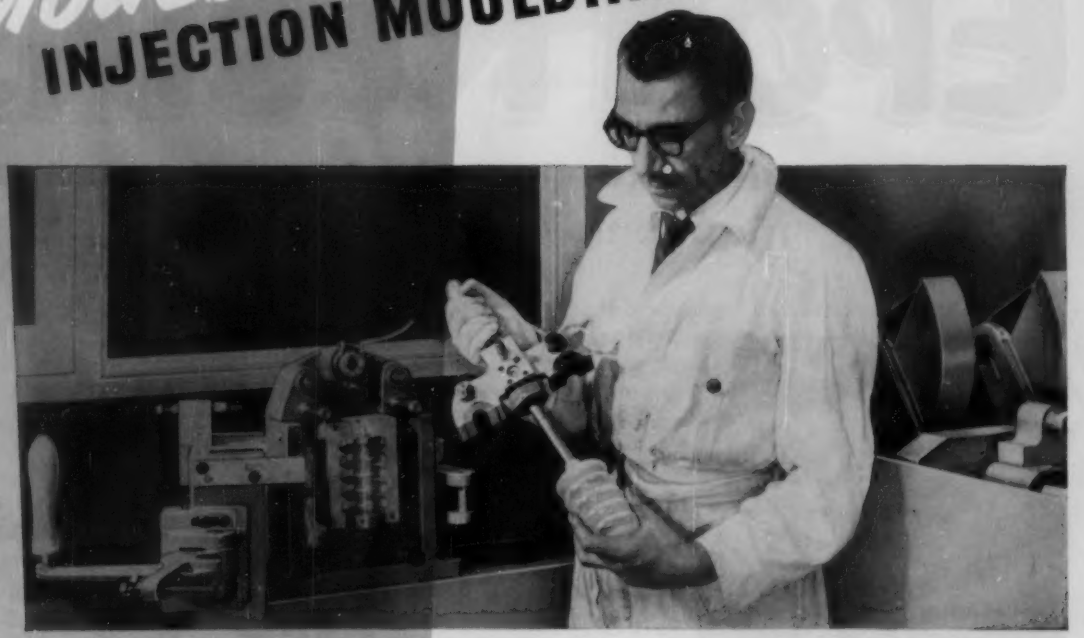

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SHELL

The Plastiscope

March 1957

News and interpretations of the news

By R. L. Van Boskirk

Section 1

Progress in polyolefin plants. Celanese Corp. has announced that its new 40 million-lb. plant for making polyolefin resins near Houston, Texas, is ready to go on stream. Polyolefin is the term now coming into general use for low-pressure-processed polyethylene and related materials that may be eventually produced from ethylene, propylene, butylene, and other olefins. Celanese points out the likelihood of future modification of the base material, by blending or otherwise, to produce a wide family of kindred resins, each tailored to do a specific job. The new Celanese polyolefin is called Fortiflex.

Other firms which are expected to have low-pressure-processed polyethylene commercially available during 1957 are: Phillips Chemical, which has stated that the first part of its 120 million-lb. plant near Houston is now ready for production; Hercules and Koppers, both of whose New Jersey 30 million-lb. plants are about ready but waiting for their ethylene supply which won't be in until early summer; Grace Chemical, expected to be ready in early fall at Baton Rouge, La.; and Bakelite with a 30 million-lb. plant at Institute, W. Va., to be ready in the fourth quarter and a 25 million-lb. plant at Seadrift, Texas, shortly thereafter. Talk in the trade is that although Bakelite already has licenses from both Ziegler and Phillips, the company may also be close to an agreement with Montecatini.

Improved transparency for polystyrene. Monsanto has introduced a new medium-impact styrene molding material, Lustrex LHA Natural, which is claimed to have improved transparency over its former medium-impact materials. It is suggested for applications requiring more impact strength than general-purpose polystyrene but with greater clarity than the high-impact styrenes afford. Especially suggested for packaging, it gives the molder a compromise choice between clarity and toughness and will reduce breakage but still provide enough clarity so that the purchaser may see the contents.

This material should not be confused with Monsanto's Lustrex Hi-Test 88B, which is a *high-impact* material with improved clarity that was introduced approximately a year ago.

New polyethers for urethane foam. A year ago the industry was told that polyether-urethane foam would probably always cost more than polyester-urethane foam. But now Wyandotte Chemicals Corp. has developed new, low-cost polyethers that are not only less costly than any former polyethers, but also lower than the adipic-type polyesters currently used. The new polyethers, based on ethylene and propylene oxide, are from Wyandotte's Plur-

* Reg. U.S. Pat. Off.

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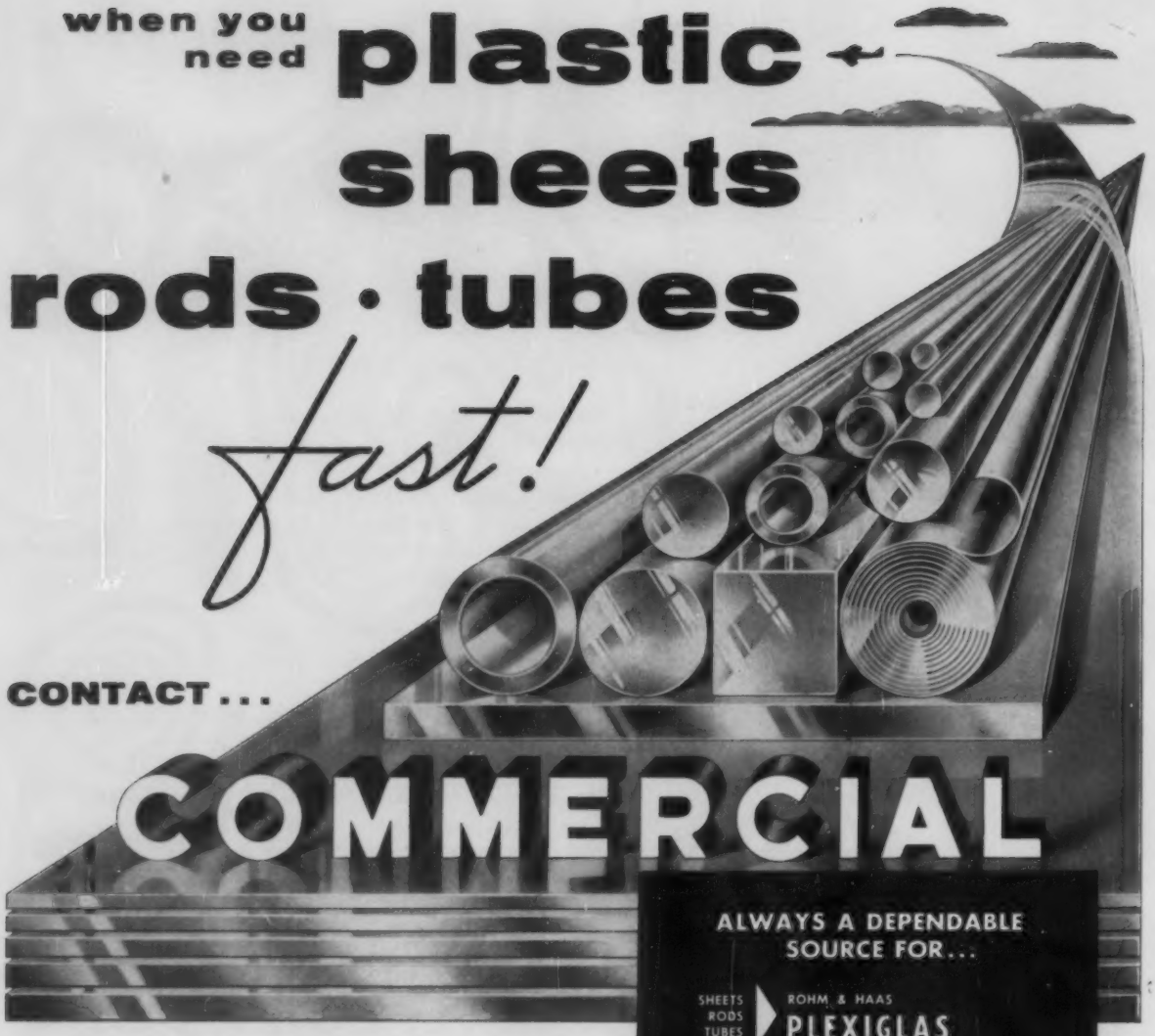

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The Plastiscope

(*Continued from p. 47*)

onic and Tetronic series of nonionic surface active agents. The price range will probably be around 30¢ a lb. in tank loads. Polyesters for use in urethane are currently 52 cents.

Probably the new Pluronics will have to be formed into pre-polymers before mixing, in contrast to the present *in situ* method of mixing polyester and isocyanate. This procedure makes for an extra step, but even so the cost of raw materials for formulation of polyether-isocyanate foam may be as low as from 40 to 60¢, while the polyester-isocyanate formulation now costs much more. A polyurethane formulation consists of from 30 to 40% isocyanate and the balance is mostly polyester or polyether. The isocyanate chemical for foam sells at approximately $1.00 a pound.

NOTE: Dow Chemical and Carbide and Carbon are also producers of polypropylene ether glycol, from which this type of polyether can be made. Will they, too, enter the field?

Who wants polyether foam? The industry has been led to believe that polyether-isocyanate foams are superior to polyester-isocyanate in several respects—especially resilience. Polyester type is reported to be 35 to 40% resilient and polyether type 55 to 60 percent. This property would supposedly make the polyethers more suitable for seat cushions and mattresses—two of the bigger markets that all foam makers are shooting for.

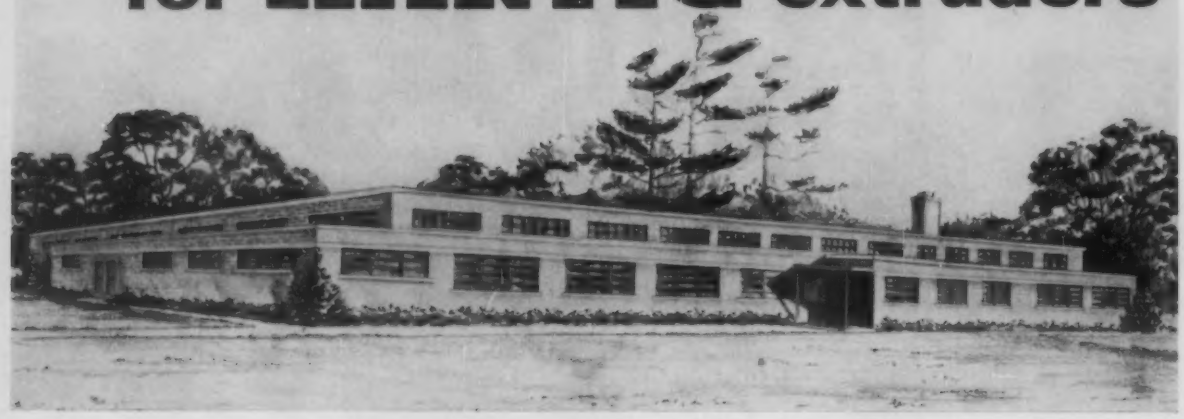
But whether or not the new Wyandotte polyethers mentioned above will perform with the same efficiency in this regard as do the older and more expensive $1/lb. polyethers based on tetrahydrofuran is yet to be proved commercially. The new materials are said to produce a softer urethane foam which is more likeable than the "boardier" polyester foams; but whether or not it is strong enough to withstand sewing and other "heavy-duty" use is not yet established. But even if polyether foams don't get the seat cushion market, they will no doubt soon be in competition for other urethane foam products, if present promises and future price possibilities are maintained.

New source for cellulose acetate. Poly-Cell Plastics Co., Smithtown, L.I., N.Y., is a new producer of cellulose acetate molding and extrusion material, according to Joseph Rosenberg, production manager. The company will buy flake and process molding material in standard colors in Groups I, II, and III in all flows, it is announced. Among first orders were sizable quantities of medium and high concentration pearl essence acetate to notions manufacturers.

Statistics for melamine dinnerware. The following figures on melamine dishes have been made available by American Cyanamid in its Melmac promotion literature. Sales in 1956 totaled more than $60 million, but only 21% of the nation's 52 million households are equipped. Definite plans to buy have been made by 6.8% of the remaining 41 million, 13.5% plan to buy, and 39.8% are favorably disposed. Twenty-nine percent bought their dishes in the last year. Ten percent of the owners have purchased a second set.

Decorative melamine dishware is thought to account for about 10% of the total, but it could be 20% or more in two years. At present it costs

The new home for HARTIG extruders



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Designed for Today's Needs... and Tomorrow's

To meet growing demand,
the Hartig organization will move to this newly-built
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Established in 1890, Hartig has been able to proceed
with the new plant because of confidence
the plastics industry has placed in Hartig equipment.
The new manufacturing facilities will enable Hartig
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Send for your copy of the new booklet describing the complete line of Hartig Extruders and auxiliary equipment.

The Plastiscope

(*Continued from* p. 49)

roughly 20% more than solid color. That difference will eventually be less. Decorative dinnerware is thought to have much more appeal for the housewife than solid color. Further design improvements, especially for family dinnerware, are such innovations as Plastimold's Lucent brand which is not only decorated but built with thin lips or edges for delicacy and then balanced by loading so that the dish won't land on its edge if dropped.

A "Melamine Council" made up of dinnerware manufacturers has just been established to stimulate sales.

New vinyl chloride plant. Great American Plastics, Nashua, N. H., has announced that its new polyvinyl chloride polymerization plant in Fitchburg, Mass., has been completely repaired, following last summer's fire, and will go on stream in late spring of this year. The company will make general-purpose calendering and extrusion polymer for sale, as well as for use in its own processing operations. Officers are Irwin Cohn, president; Melvin Rosensaft, vice president in charge of manufacturing; and Charles Sussman, director of sales. Mr. Cohn states that he will enter the styrene polymerization field later.

Plio-Tuf sheet supplier. Goodyear's Plio-Tuf resin is now being calendered into sheet by Charles Crowl Co., El Monte, Calif. It is suggested for thermoforming such products as airplane and auto parts, machine covers, display panels, window frames, and refrigerator door liners. A recent application is a typewriter pad; the sheet covers a foam pad to provide a firm base and protect the foam from oil and cleaning fluids. This Plio-Tuf sheeting has no relationship to Crowl's styrene-vinyl sheet described on page 129 of this issue.

When introduced two years ago, Plio-Tuf was identified as a styrene-butadiene resin without rubber; but Goodyear has made no statement concerning its content since then. It fits in between conventional high-impact styrene and the higher-cost modified acrylonitrile-styrene sheets such as Royalite. It is claimed to be tougher than high-impact styrene sheet—even as tough as some of the acrylonitrile-styrene sheets and is often suggested for the same markets. In some respects, its toughness resembles that of the super-impact modified styrenes, such as Bakelite 2155 or Dow 480, but it is a calendered sheet, while the latter two are extruded. It is claimed to run faster on a calender than other rigid-type sheeting.

The price of Plio-Tuf resin for sheeting is 37¢ a lb. in carload lots. Two years ago, it was 52 cents. Injection molding pellets are 41¢ a pound.

CCDA concentrates on plastics. What's going on in plastics and some of its future possibilities will be the general subject of a one-day conference of the commercial Chemical Development Association's meeting in New York on March 28. Some of the topics that will be discussed by various speakers and panels are: the position of the plastics industry in relation to other industries; trends and potentials relating to financial aspects of the industry; the fabricators' share of consumers' dollars; the consumers' opinion of plastics; capacity for production; new markets; and product development and technical service.

The program would indicate that the CCDA is extremely ambitious

Here is a dramatic demonstration of the extra rigidity in Spencer Chemical Company's important new polyethylene discovery, "Poly-Eth Hi-D." This improved rigidity permits, in many cases, a reduction in wall thickness without loss in strength. Molders report savings of up to 5c a pound on material costs.

Material Costs Cut 5c a Pound by Using NEW, STURDIER Polyethylene

Remarkable new Hi-Density "Poly-Eth" by Spencer offers you production savings, superior products, new profit opportunities

It often actually costs less to mold polyethylene products with Spencer Chemical Company's new discovery, Hi-Density "Poly-Eth"! That's because "Poly-Eth Hi-D," with a density ranging from .935 to .940, is so much more rigid than ordinary polyethylene that it takes only 69% as much material for a given rigidity. With the reduced quantities of polyethylene necessary, you can often make savings of up to 5c a pound on material costs.

As a boilable, see-through film, "Poly-Eth" has striking advantages, too. Unlike other boilable plastics, it can be heat-sealed. And—because it offers protection at less cost—it greatly increases opportunities for packaging food in boilable see-through packages. This sturdy low-cost film is also excellent for many other uses — such as packing acids, volatile chemicals or metal parts.

Many other profitable new products are possible with super-rugged "Poly-Eth Hi-D." The products can have the advantages of conventional polyethylene PLUS the advantages shown in these pictures. Those advantages include improved tensile strength and rigidity, and increased heat resistance.

Only Spencer offers you commercial quantities of this new polyethylene. So, for more information, contact your nearest Spencer sales representative, or write to Spencer Chemical Company for a "Poly-Eth Hi-D" data sheet.

SEE "POLY-ETH" IN ACTION
National Packaging Exposition
Chicago, Ill. . . . April 8-11
BOOTH NO. 895

Cooking in "Poly-Eth Hi-D" bags has been tested with many foods in Spencer laboratories. What product would *you* like to package in a film that will withstand 240° F?

Stiffer than ordinary polyethylene, "Poly-Eth Hi-D" doesn't wilt when filled with hot liquid, and it has clarity and high gloss of high pressure polyethylene.

SPENCER CHEMICAL COMPANY
Dwight Bldg., Kansas City 5, Mo.

The Plastiscope

(Continued from p. 51)

regarding plastics. Any one of the above topics is a subject that could profitably consume several days of conference time. If the CCDA folks are able to condense the whole business in one package, the plastics industry will have a whole library of valuable information in one volume.

Plasticizer price reduction. Monsanto has reduced the price of Sancticizer 140 (cresyl diphenyl phosphate) and tricresyl phosphate from 34½ to 32½¢ a pound. Both are primarily flame-retardant materials, contribute to plasticizer permanence because of low volatility, and weather well. Santicizer 140, one of the most permanent of monomeric plasticizers, is said to give better low-temperature flexibility, compatibility, and hand. TCP may yellow a bit more than this other phosphate, but it has even better permanence and is used particularly in vinyl wall tile and wire coating where its low-temperature flexibility, good aging, and electrical properties are advantageous.

Unplasticized vinyl chloride cans. Fish, margarine, and delicatessen-type foods packaged in calendered, unplasticized, clear polyvinyl chloride film, mostly 8 mils thick, are now being shown in the United States by David Greenfield, 3143 Decatur Ave., Bronx, N. Y., who is the representative for Anorgana Co. of Germany. The can bases are produced at high speed on a stamping press, using preheated film. The top is vacuum formed and then crimped on the base with a metal ring for fish cans; the margarine package requires no metal ring. The stamping process involves less than vacuum forming. The film or sheet can be drawn half its diameter or more; thus an 8-in.-diameter disk can be drawn 4 in. deep and film as thin as 5 or 6 mils can be handled. The material is of the unstretched variety so there will be no shrinking and it is claimed to be stable at 212° F. Price in Hamburg, Germany, is 65¢ a lb. for 12 mil, 68¢ for 8 mil thickness. Delivered cost in the United States is about 16% more. The weight saving over tin is substantial; specific gravity of polyvinyl chloride is about 1.35, tin about 7.5. What is needed most in the United States to take advantage of this light, durable, transparent can is equipment that can handle it in the filling operation.

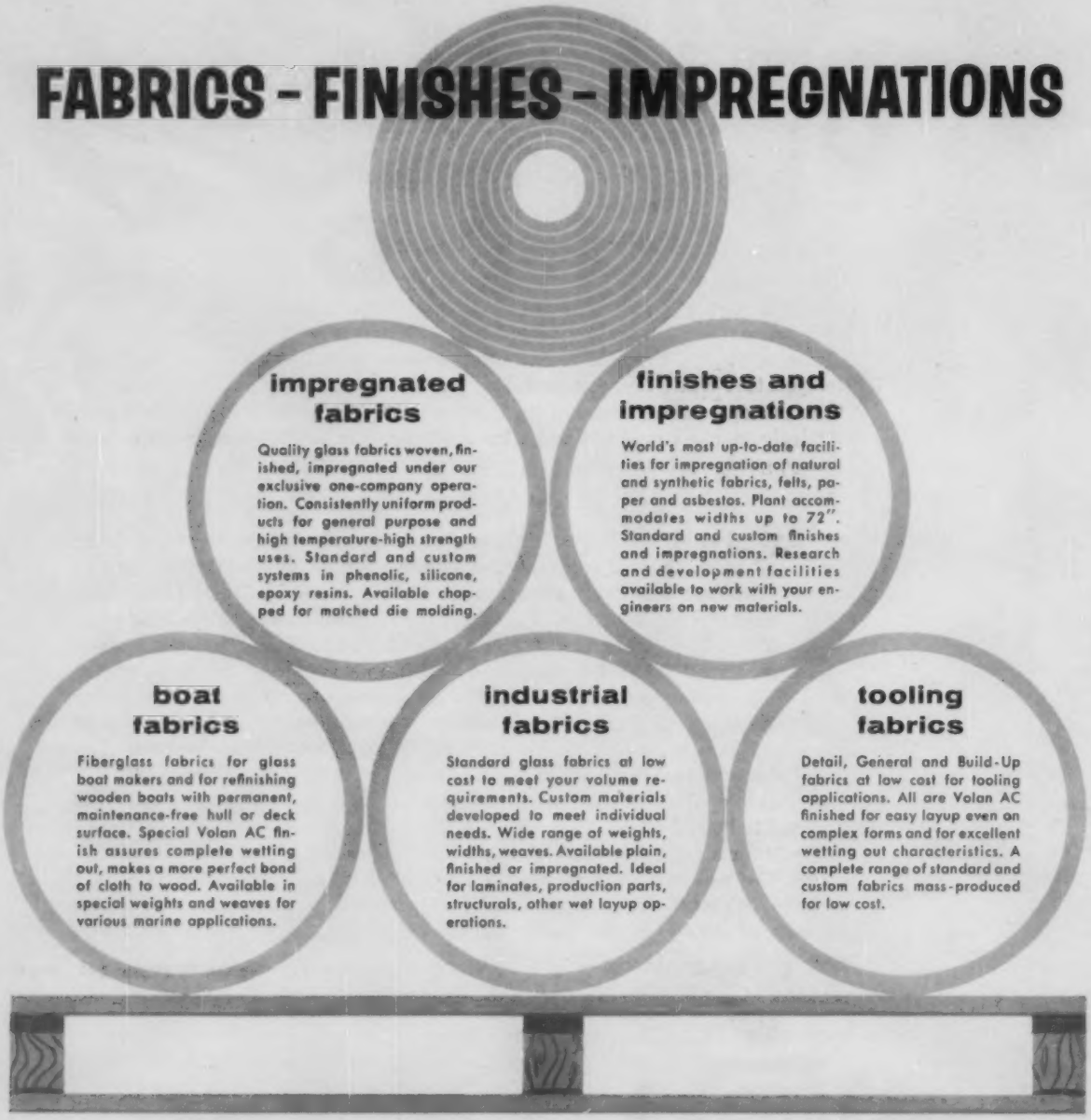
Bottles from vinyl film. The same representative mentioned above is responsible for demonstrating that Anorgana's unplasticized, clear film can be used for producing bottles made from one piece of film. The process, a combination of vacuum forming and side sealing, produces bottles of various shapes. Advantages claimed by Anorgana for such bottles are negligible water-vapor transmission, greaseproofness, and strength.

Close kin to the bottle film is Anorgana's continuous length tubing, in unplasticized clear vinyl film from 1 mil up, furnished in flat widths from 2 to 20 inches. It is suggested for bags where it is claimed a 1-mil film would be as strong as some competitive films of 5-mil thickness. It is also claimed that there is only negligible danger of ruptured seams at the boiling point since the material is asserted to be heat stable at 100° C.

For additional and more detailed news see Section 2, starting on p. 298

one company source for

FABRICS - FINISHES - IMPREGNATIONS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Quality glass fabrics woven, finished, impregnated under our exclusive one-company operation. Consistently uniform products for general purpose and high temperature-high strength uses. Standard and custom systems in phenolic, silicone, epoxy resins. Available chopped for matched die molding.
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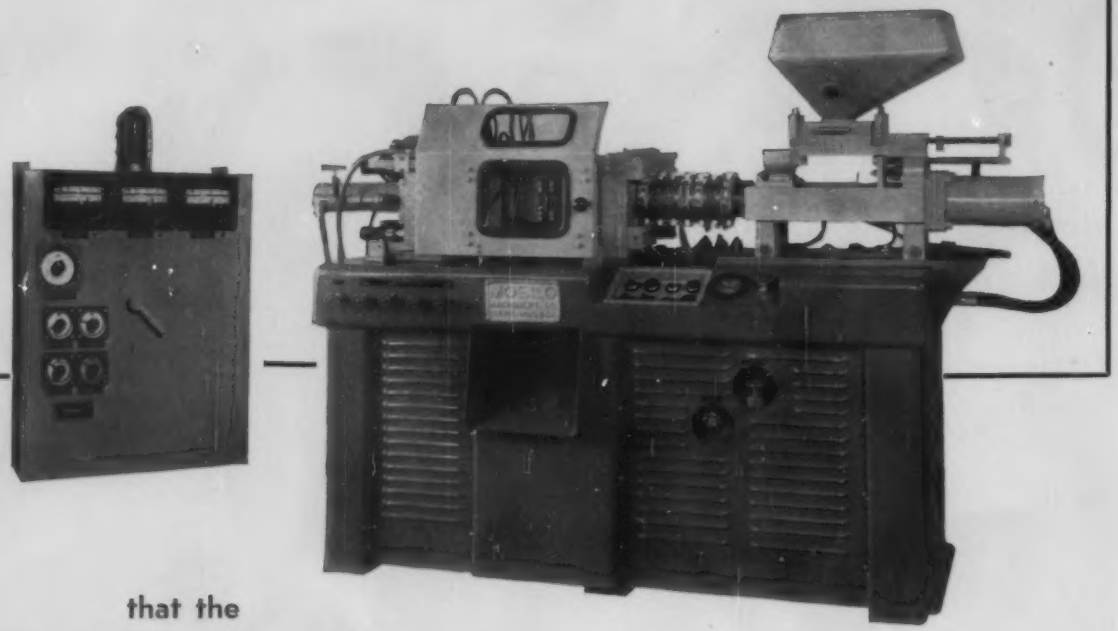

that the

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Your Profits

It is said "Proof of the Pudding is in the Eating." Likewise, "Proof of Performance is in Demonstration"—and that is exactly what the Moslo Machinery Company is going to prove to you.

From March 11 through April 13 the Moslo Engineering Staff in co-operation with their west coast representative, the Rainville Company of California, Inc., will have a two ounce and a three ounce model of the famous Moslo line in actual operation.

You are cordially invited to visit this private showing to be held from 9 to 5, in our display room at 625 West Jefferson Street, Los Angeles, California. We would welcome the opportunity to demonstrate the machines on exhibit, *using your own molds and materials.* Full capacity shots no problem.

When you actually see this production performance, you will prove it to yourself that a Moslo injection molding machine is the world's fastest and most advanced design.

Come in or contact either our Cleveland office or our west coast representative to arrange for an appointment.

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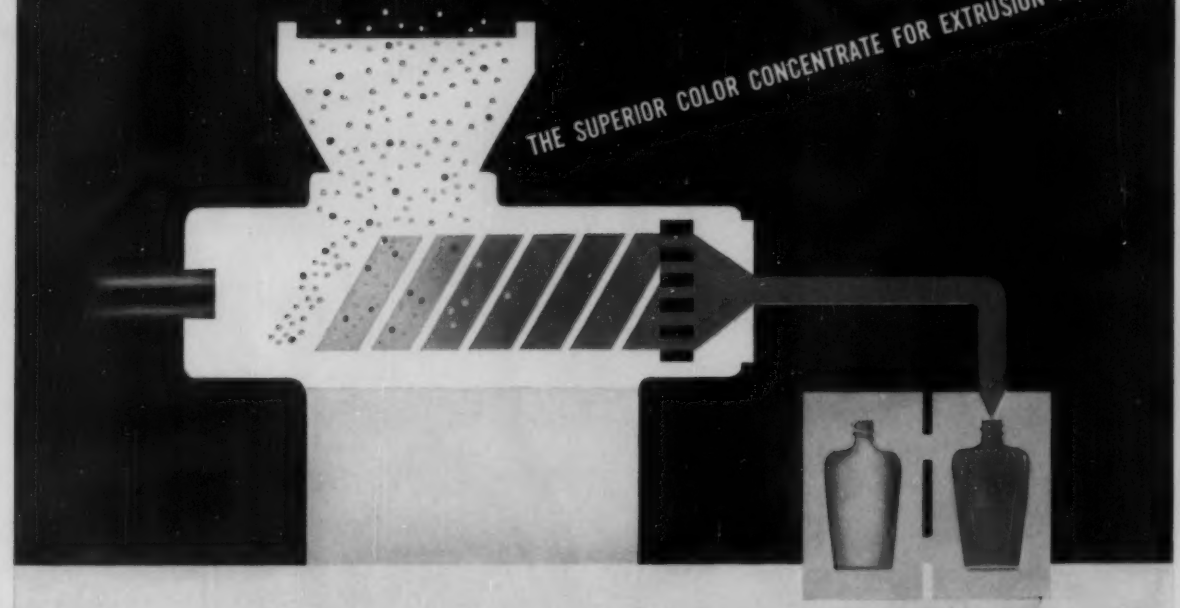

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UNICOLOR is a resin color concentrate that forms a molecular bond with the thermoplastic involved. It is to be used at a ratio of **twenty-four to one.** The result is a uniformly finished color at the cost of a few pennies per pound.

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remember! it's the color that makes the SALE!

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The Famous WINDSOR *Single-Stage Multi-screw Pre-plasticisers*

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Hand or semi-automatic cycle control
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A.P. 1044. Capacity molded per shot 44 cubic inches equal to 32 ounces C.A. Locking pressure 330 tons. Projected area 160 square inches.

A.P. 2088. Capacity molded per shot 88 cubic inches equal to 64 ounces C.A. Locking pressure 550 tons. Projected area 300 square inches.

Literature illustrating the full range of machines is available on request.

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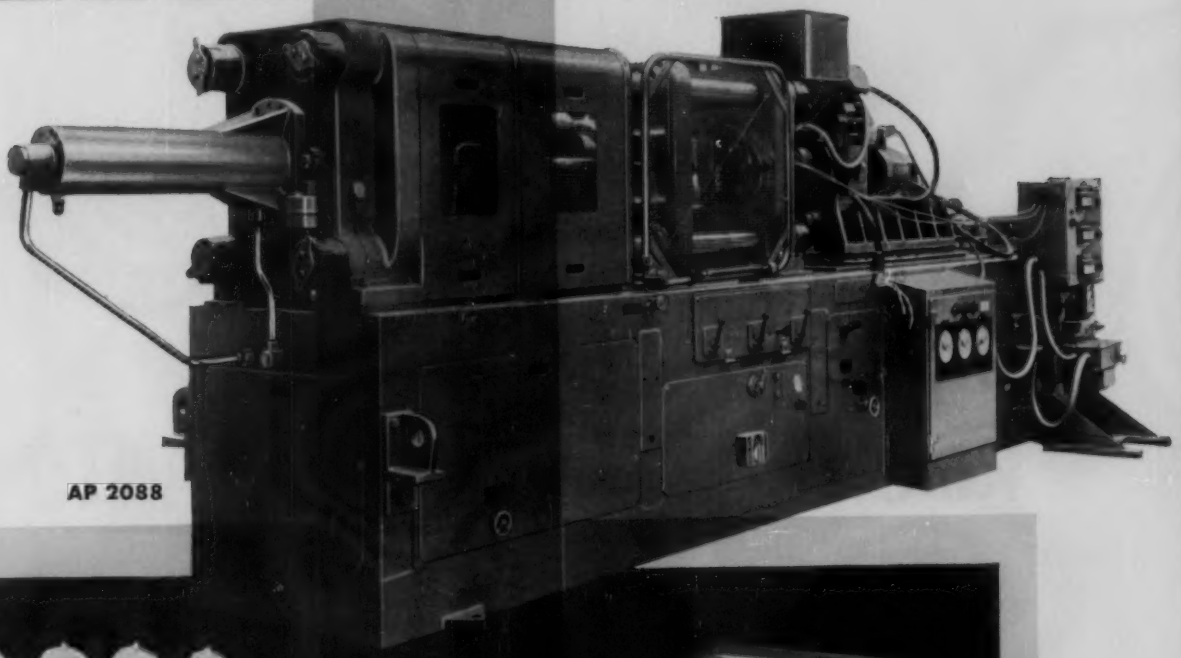
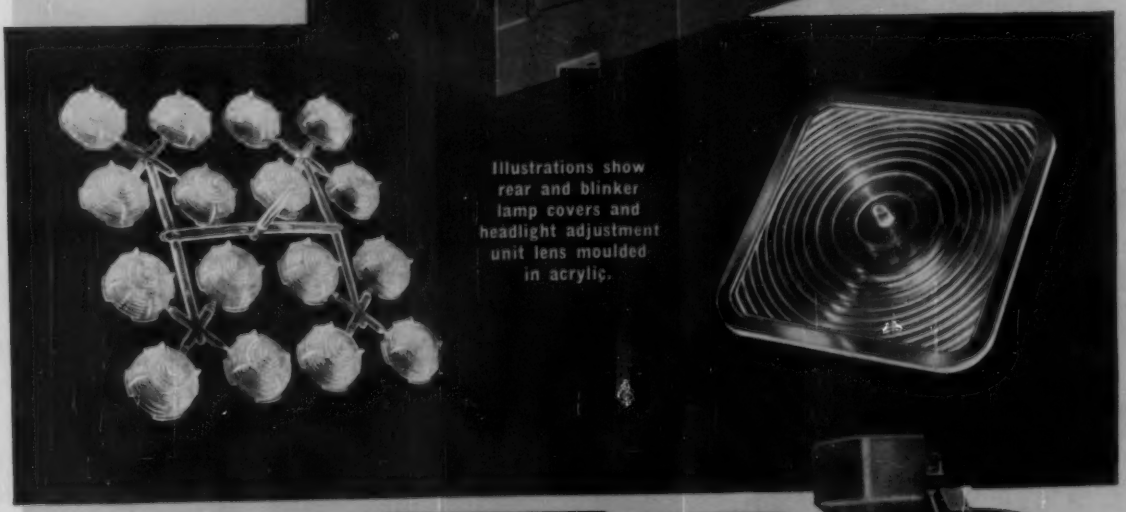
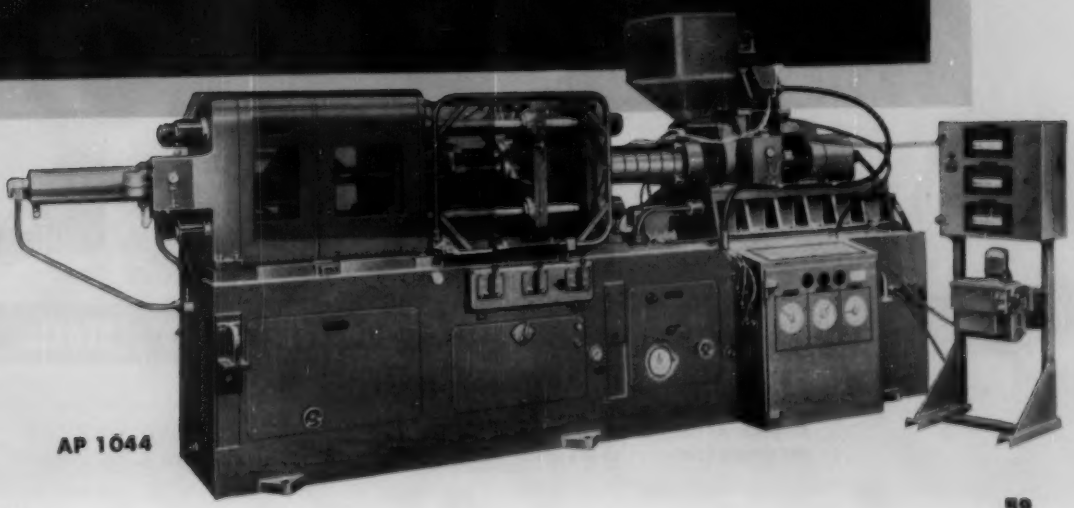
Plastics Production



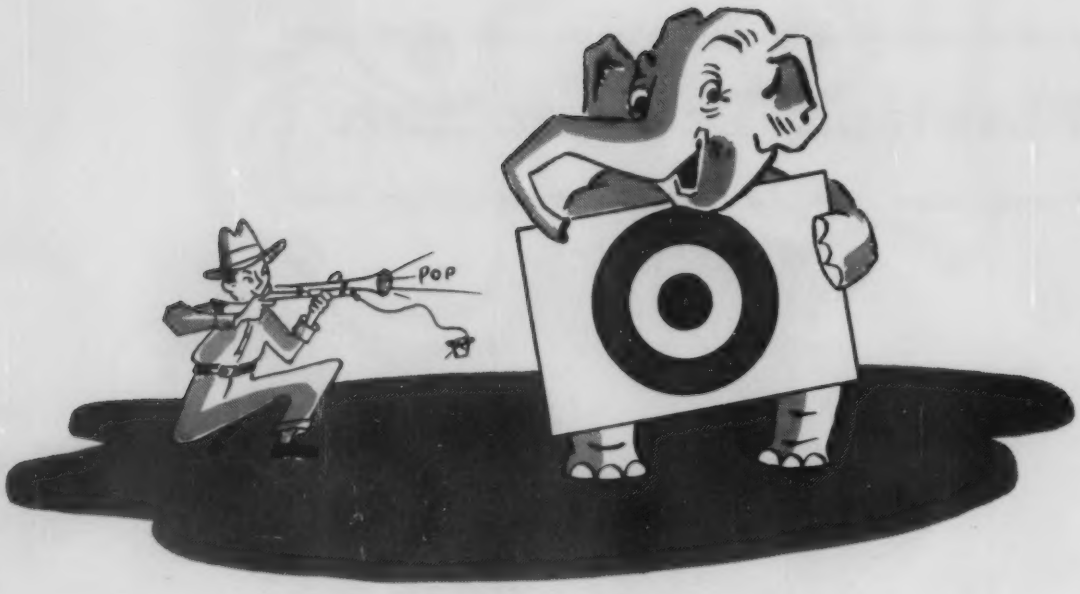
AP 2088



Illustrations show rear and blinker lamp covers and headlight adjustment unit lens moulded in acrylic.



AP 1044



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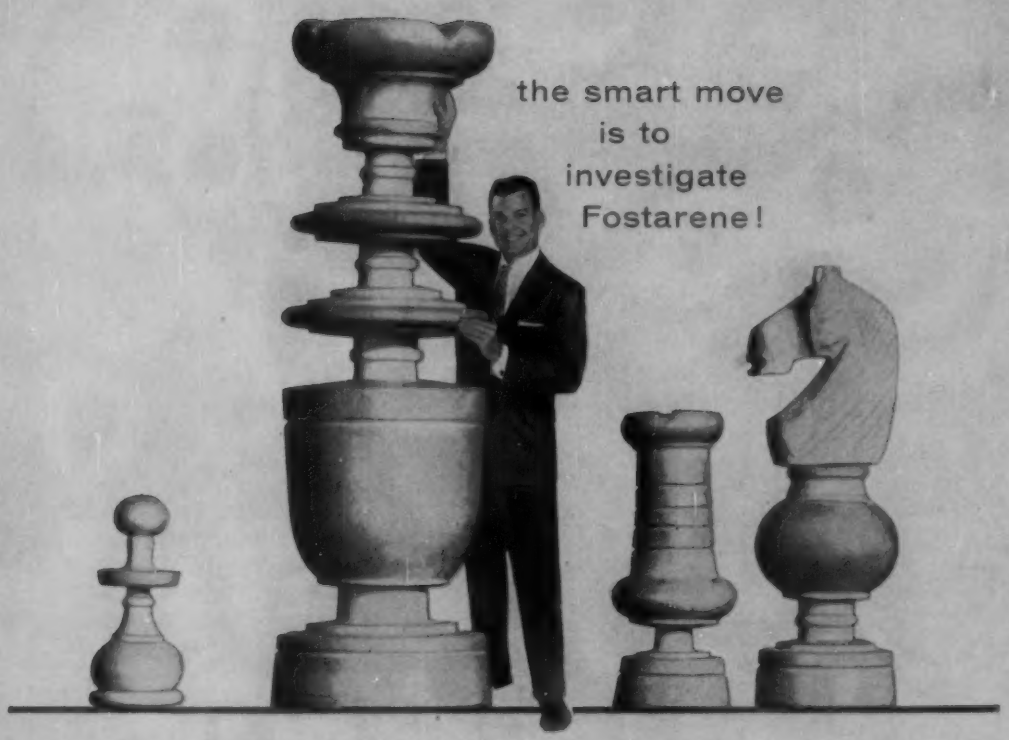

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Fostarene is a product of a pioneer in plastics for over 30 years. In talent and equipment, Fostarene's research facilities are second to none . . . *and growing!*

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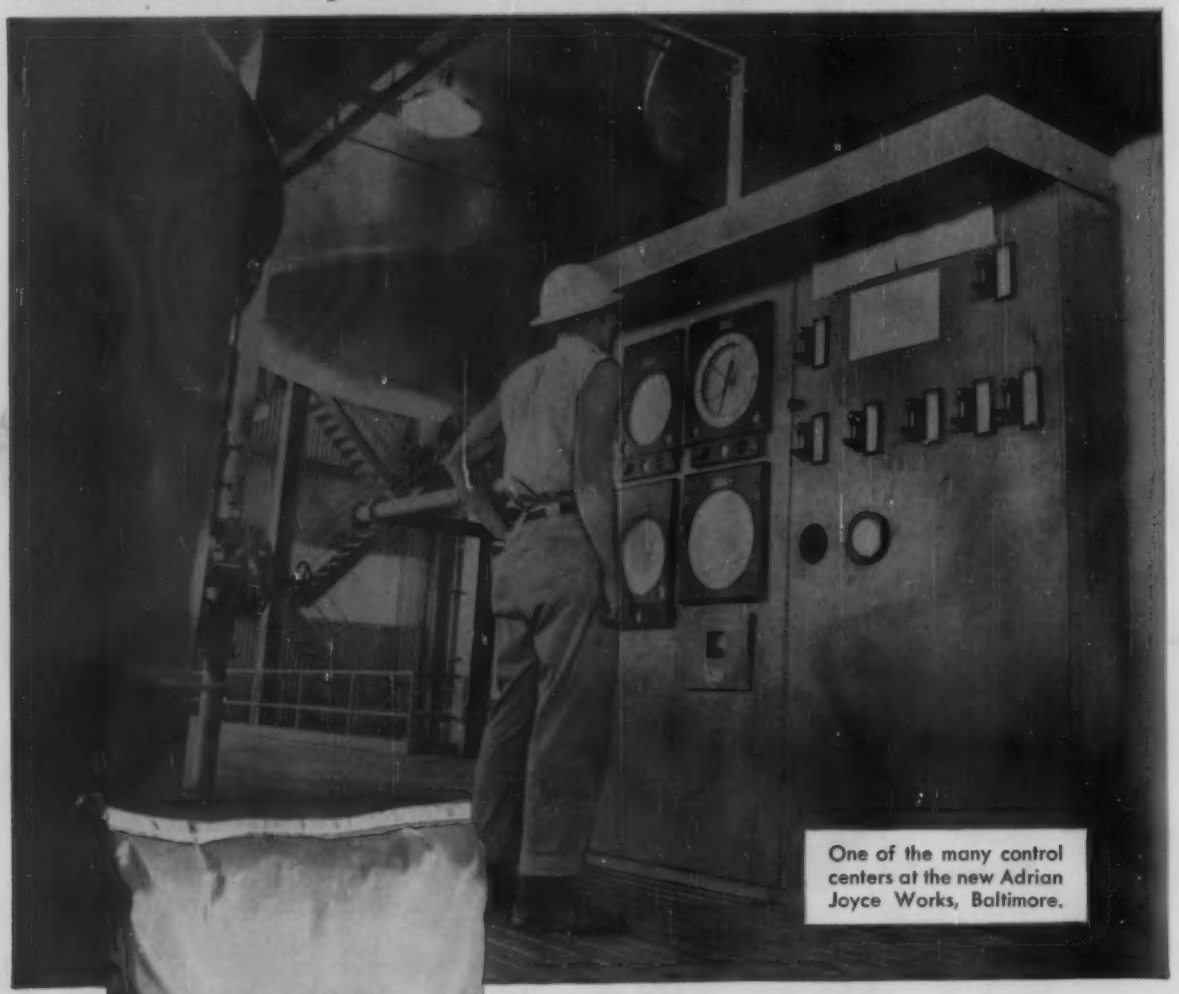

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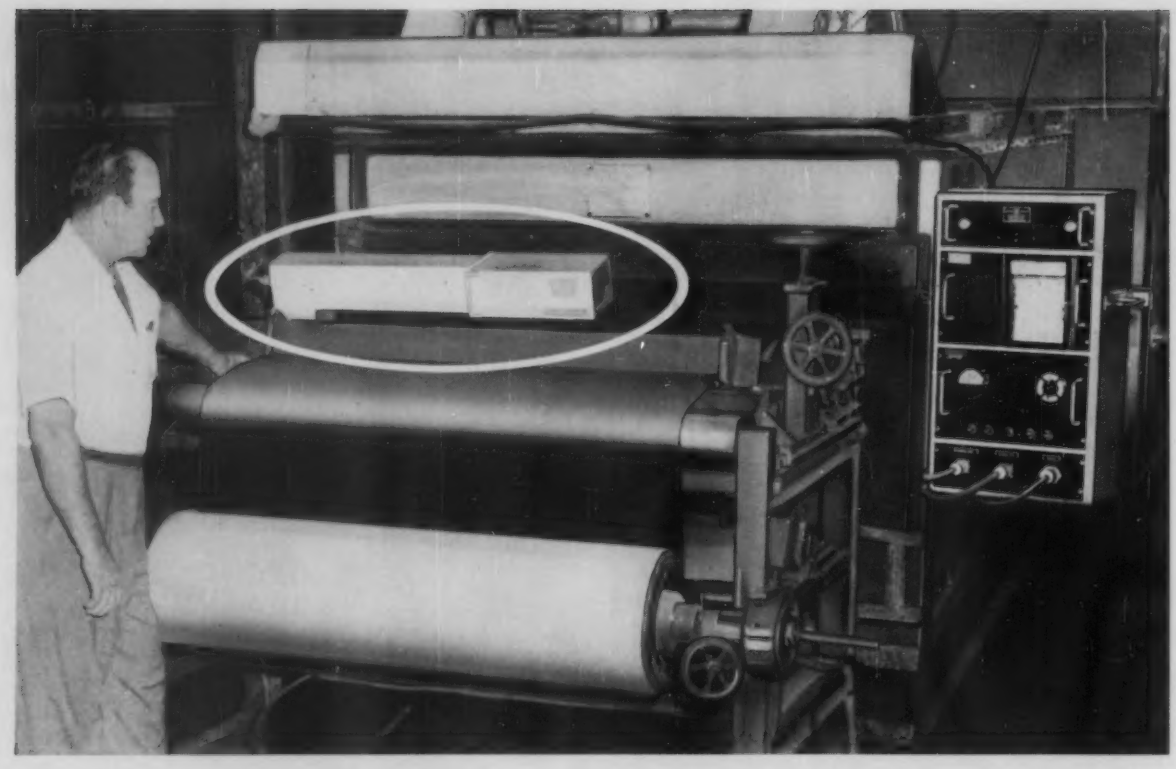
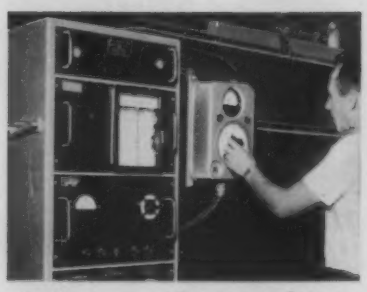
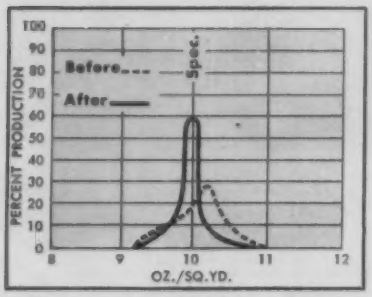


NEW PRECISION IN COATING CONTROL



Machine operator adjusts target selector to proper weight specification for each order. Target meter acts as constant guide, indicating variations immediately.



Before installation of the Curtiss-Wright System, only 55% of plastic produced came within ± 2% of the target weight of 10 oz./yd.^{2} After installation, 86% of total production met specification.

With CURTISS-WRIGHT Systems

Tested and proved in the most exacting production applications, Curtiss-Wright non-contact measuring systems and controls monitor plastic film, sheet and coated stocks continuously. They record actual production quality, signal instantly any variations that occur and make correcting adjustments automatically in the production equipment.

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Celluloid in sheets, tubes and rods.

WOPALON

Cellulose Acetate in sheets, tubes and rods.

WOPALIT

Acetate powder for injection molding and extrusion.

WOPAVIN

PVC (Polyvinylchloride) in calendered and pressed sheets, tubes, rods and profiles. Compounds for injection molding and extrusion.

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3 important ways...

BY ELIMINATING:

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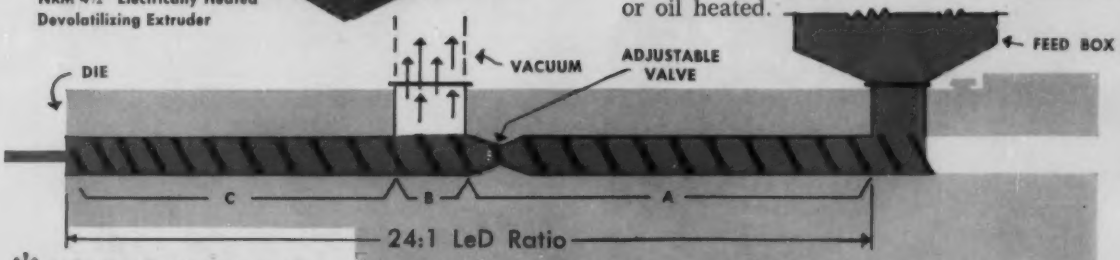
YOU SPEED PLANT OPERATION, PRODUCTION AND PRODUCE EXTRUSIONS OF HIGHEST QUALITY...

NRM Devolatilizing Extruders "short-cut" the time-taking, expensive methods of extruding on conventional machines such materials as cellulose acetate and butyrate, ethyl cellulose, acrylic and others. Since compounds like these require removal of moisture and other volatile constituents in order to produce non-porous, top quality extrusions, processing them can be done faster and less expensively on extruders designed especially for the work.

NRM 4½" Electrically Heated Devolatilizing Extruder

Where moisture only need be removed, pre-drying hoppers work well enough, although they are unwieldy, hard to manage and require excessive headroom. Where elements must be removed which reach evaporation point only inside the extruder, material must be extruded repeatedly — unless a means is provided to "vent" these constituents on the *first run*.

NRM Devolatilizing Extruders provide this means of "venting" volatile elements in the first run . . . The integrally-built cylinder vent illustrated in the accompanying sketch removes gases released by the plastic as it is plasticized. Additional heating and mechanical working of the plastic as it travels through the extra long cylinder assures highest quality extrusions, free from porosity. Because of a greater ability to disperse color, these extruders are also effective in cutting processing costs and increasing quality where colored compounds are extruded in any quantity. If you work with plastics requiring devolatilization, you can cut production costs, speed up the work and increase your ratio of profit with our Devolatilizing Extruders. While their design is special, they are *standard* in our line. They are obtainable in all sizes, and may be either electric or oil heated.



* *Volatile constituents in the plastic causing porosity are "vented" as follows: Plastic is heated, plasticized, and volatile elements brought to evaporation point in stage A. In stage B, plastic releases gases which escape through vent built integral with the cylinder. In stage C, material is further heated and worked, completing the extrusion cycle.*

Write today for more details, quotations, or to arrange a demonstration. There's no obligation.

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General Offices and Engineering Laboratories: 47 West Exchange St., Akron 8, Ohio. HEmlock 4-1961

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MID-WEST: National Rubber Machinery Co., 3073 N. Lincoln Ave., Chicago 3, Ill. LOngbeach 1-0328

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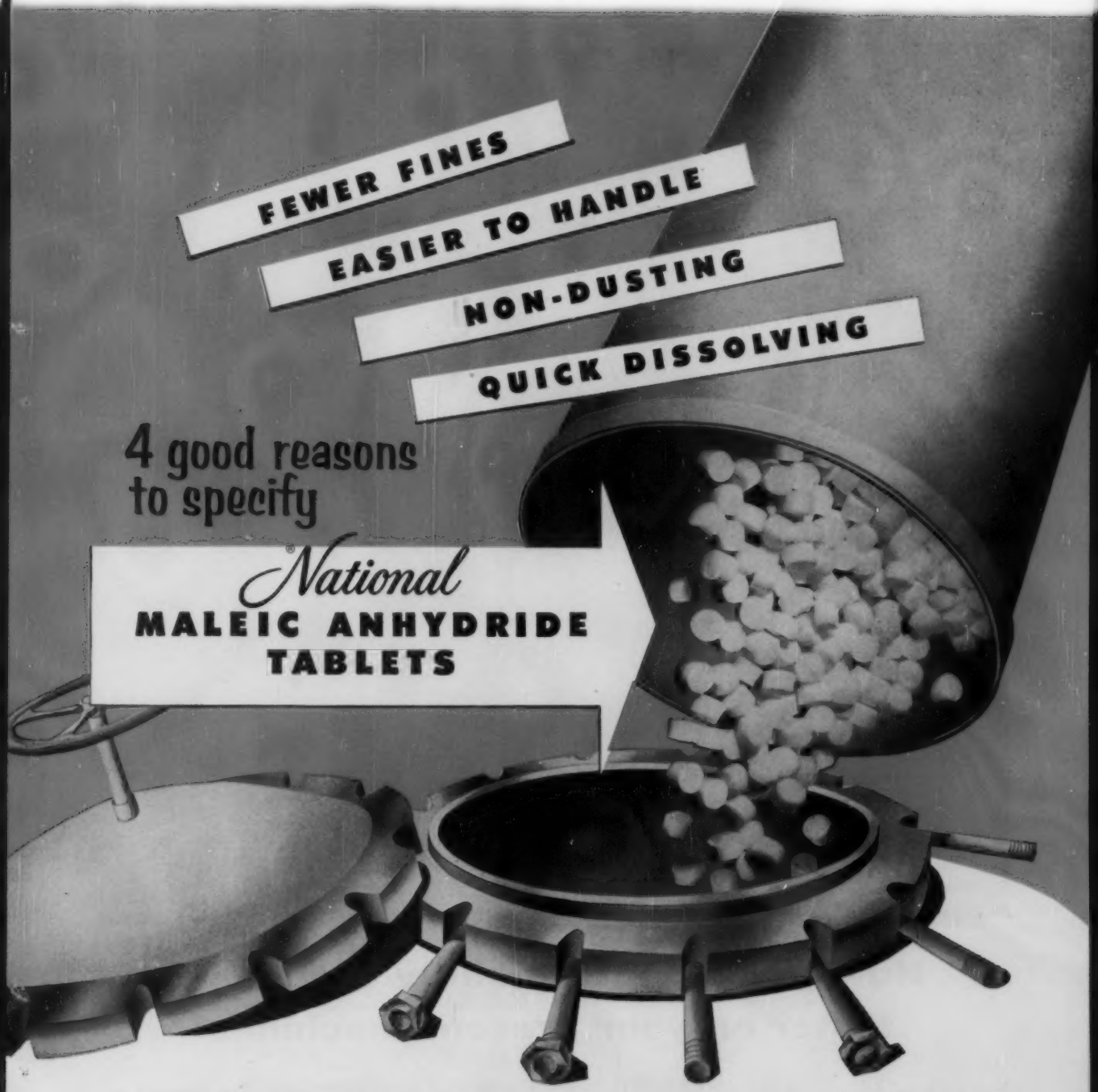
Jack Bryan, Industrial Director **Dept. G** **St. Petersburg, Florida**



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Qualitative screen-analysis proves these tablets have up to 90% fewer fines "as delivered". Quick dissolving, uniform, easier-to-handle National Maleic Anhydride Tablets are the best value your money can buy. And there's no price premium on this premium product.

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How to get better quality extrusions faster on your present machines!

Here's a brand new product that will help you increase production on your present extrusion and injection molding machines. It's the new Chromalox Electric Heater Band. Designed to fit heating barrels of most diameters, Chromalox Heater Bands step up barrel temperatures . . . leading the way to faster molding cycles and faster extruding.

The new style Chromalox strip heater gives maximum heating surface in contact with the barrel. The new special alloy clamping band keeps the heater in firm, even contact with the barrel at all temperatures . . . resulting in more efficient heat transfer. This means added heater life.

What's more, temperature ranges have been extended to 700° on the barrel. Coupled with increased heater efficiency and service life, this lets you shorten work cycles, increase the capacity of your machines.

Check into the possibilities of upgrading the performance of your present machines by converting to the new Chromalox Heater Bank. Contact your Chromalox representative . . . he's the man with the electrical answer to all your heating problems.

For more information on the new Chromalox Heater Band, write for a copy of Bulletin SP-2508.

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Fine for a little quiet enjoyment, maybe, but not when you're faced with a definite need. Moulding, for instance, rules guesswork out completely. You simply *must* be sure about it. The moulding efficiency of Kleestron polystyrenes, endorsed by our many customers, means that you can be. That's because our considerable resources are devoted to taking the chance out of moulding. So why not bring your moulding problem to us?

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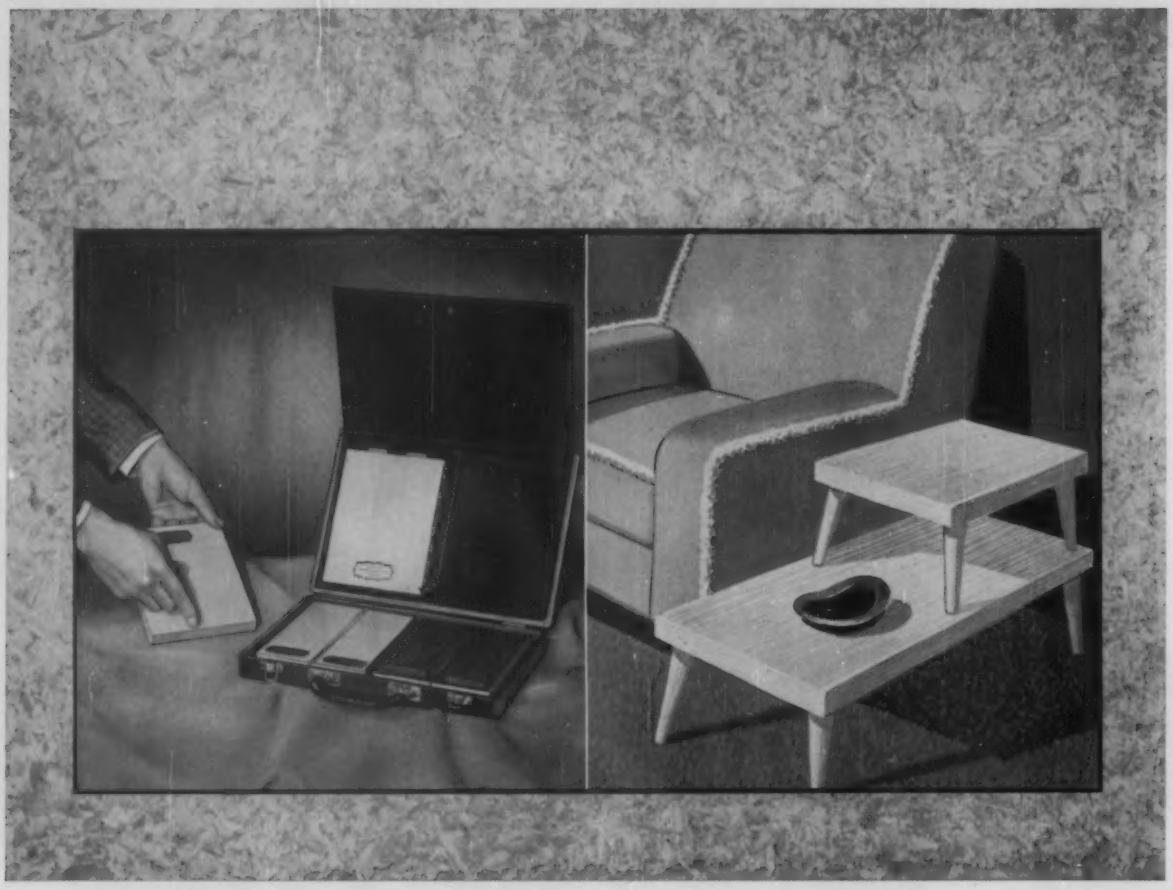
AN IDEAL BASE FOR BETTER PRODUCTS



WEYERHAEUSER 4-SQUARE PARTICLE BOARD—
is smoothly sanded for plastic overlays

WITH LAMINATED and veneered products, it's the surface that sells! Yet a smooth, attractive surface depends, to a large extent, on the core material to which it is applied.

That's why it's good business to start your production with a core stock especially engineered for the job . . . 4-Square Particle Board, a product of Weyerhaeuser research. This new and better core material comes to you sanded smooth on both sides and completely free of grain and knots. It is all ready to go to work without preliminary processing in your plant.

Produced in densities for both 3 and 5 ply laminations of wood veneers or decorative plastics. Laminations may be mounted using either pressure or pressure sensitive adhesives. Can be edge-glued to obtain longer lengths and to utilize trim waste. Easy to work with regular wood-working equipment.

4-Square Particle Board is manufactured in thicknesses of 3/8", 1/2", 5/8", 3/4", and 1"; densities of 30, 35, 40, 50, and 60 lbs. A Weyerhaeuser representative will be glad to work with you in selecting the thickness and density best suited to your requirements.

Weyerhaeuser offers Hardboards to meet your needs, too! Thicknesses from 1/12" to 1/4". Three types: Standard, Lower Density, Perforated!

Weyerhaeuser Sales Company
DEPARTMENT PJ-37
First National Bank Building • St. Paul 1, Minnesota

Have you seen this Kit?

Shows actual samples of plastics and veneers mounted on 4-Square Particle Board with various types of edging. Your Weyerhaeuser salesman will be glad to show it to you on his next visit!

—with an eye to your future . . .

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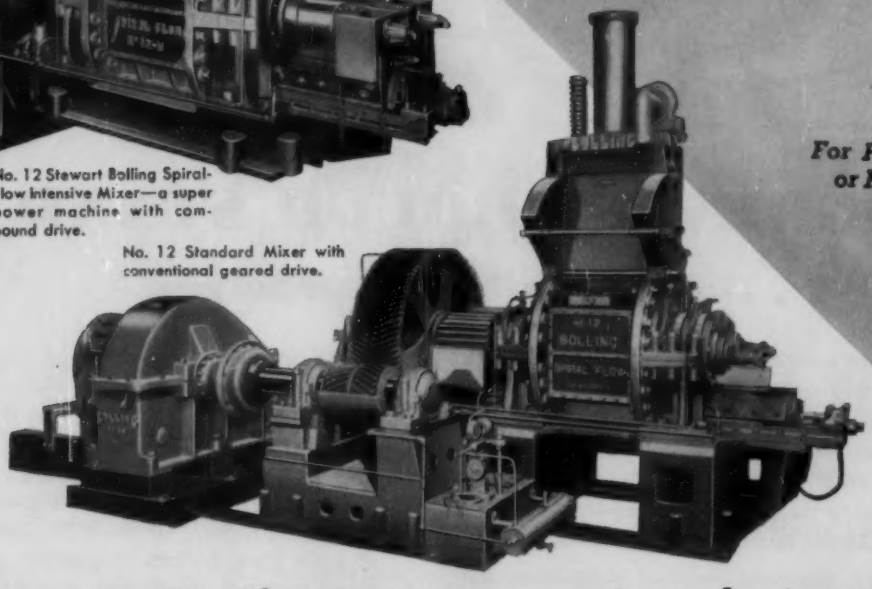
INTENSIVE

MIXERS

No. 12 Stewart Bolling Spiral-Flow Intensive Mixer—a super power machine with compound drive.

No. 12 Standard Mixer with conventional geared drive.



For Plastics or Rubber

The Complete Line that meets tomorrow's production today!

Bolling builds 4 production sizes for a range of capacities: No. 3 (3400 cu. in.), No. 4 (5100 cu. in.), No. 10 (12160 cu. in.), No. 12 (16000 cu. in.). Also one production-laboratory model —No. 1B (1200 cu. in.). Also one laboratory model—No. 0 (275 cu. in.).

In Bolling mixers, laboratory or production size, you get:

Spiral-Flow Sides for the heating or cooling of stock, which give greater thermal efficiency . . . *Split End Frames* which permit rotor removal without completely dismantling ends of machine . . . *Anti-Friction Bearings* for optimum power, smoother running, and longer life. No end zone movement of rotors . . . Stewart Bolling production mixers offer other outstanding advantages for profitable operation; rotors with full circle end flanges; compound, dual or conventional geared drives, and other features.

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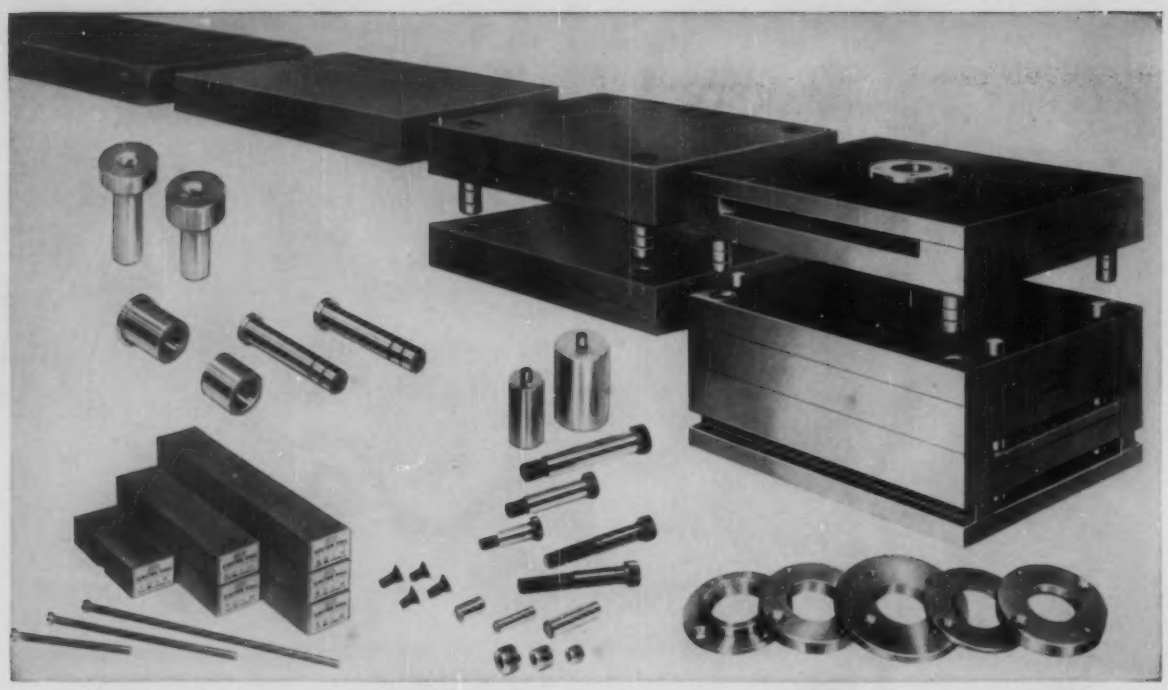

PROGRESS THROUGH STANDARDS

. . . and how DME "helped"

The history of economy in modern business has been directly related to the history of Standardization. One of the major elements affecting the economic production of finished plastic parts is the high initial cost of the mold. A progressive step in reducing mold cost, without sacrificing the high quality required, has been successfully achieved through Standardization.

When D-M-E originated Standard Mold Bases and their component parts in 1942, it provided the answer to the rapidly growing demand for high quality molds that would maintain and promote the economic advantages of plastic parts.

Through large volume purchases of quality steel in standard sizes and specialized production facilities, D-M-E was able to produce and supply high quality Standard Mold Bases to mold makers and molders at such great savings in cost and time that the benefits of Standardization were quickly realized by the Industry.

Today D-M-E produces twenty-two different sizes of Standard Mold Bases, from 9" x 8" to 18" x 35½", in either D-M-E No. 1 or No. 2 Steel, with a wide range of cavity plate thicknesses to satisfy the diversified demands required. In addition, over 2,000 finished component parts of the same high quality are available to provide additional savings in service as well as in the product.

Properly engineered Standardization puts the accent on Economy. When you "Specify D-M-E . . ." you get Quality, Service AND Economy!

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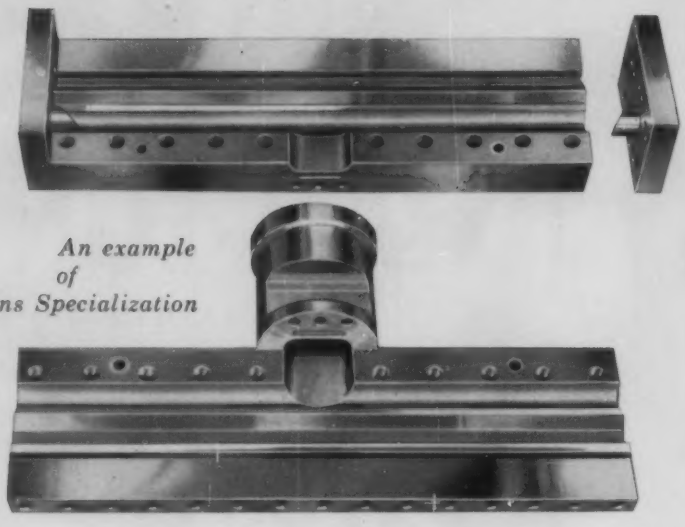

An example of Robbins Specialization

We're fussy about dies... fussy because YOU make us that way

Your dependence on the exactness of Robbins dies insists on rigid controls throughout their production. For example, a Robbins die gets its start when special die steels are brought into our plant and inspected. This steel is sent to our heat treat department for annealing and then re-inspected. It is then straightened and ground all-over. After grinding, the die blocks are rough planed and checked for straightness and stress. The die is then put on a vertical mill and all cavities milled to fifteen thousandths of finished tolerance. The die is then drilled and tapped and the adapter made. After this, it goes to our grinding department where all radii, angles and flats are ground plus or minus one-half thousandths. Again the die is re-checked for straightness and if within tolerances it is polished, lapped and sent out to be chromium plated by our special process. When returned, all mating surfaces are re-ground to assure a good fit. The die is then inspected, assembled and readied for shipment.

Call it fussiness . . . Call it experience . . . Be sure, Call on Robbins for your plastic extrusion sheeting dies.

Robbins
never say die . . . say Robbins die

PLASTIC MACHINERY CORP.

1430 Mishawaka Street · Elkhart, Indiana

Strip away five plastisol processing troubles with "Dutch Boy" Stabilizers

...simplify organosol production, too

Stabilize vinyl plastisols with "Dutch Boy" and you go a long way towards solving five common problems.

The first is high heat sensitivity in dispersion resins for plastisols (and organosols). "Dutch Boy" Stabilizers cut this sensitivity down.

Then come three molding problems . . . plate-out of colorants, hard stripping, discoloration from interaction of product and mold. "Dutch Boy" Stabilizers help overcome these three.

Lastly, there's the tendency of stored dipping or spreading plastisols to build-up viscosity. "Dutch Boy" Stabilizers help keep these compounds at best working body.

There are "Dutch Boy" Stabilizers for every plastisol or organosol

Take brightly colored fabric coatings for outdoor use. "Dutch Boy" Dyphos® supplies the ultra-violet screening they need.

Take "clears". Take toys. They call for a stabilizer that gets along well with sensitive plasticizers . . ."Dutch Boy" Provinite.

Take injection molded "opaques". "Dutch Boy" Tribase and DS-207® team up to protect them against high heat.

So it goes. There are "Dutch Boy" Chemicals for every stabilizing problem you may run into with vinyl plastisols or organosols.

For every bodying problem, too! Look into "Dutch Boy" BENTONE® Gelling Agents to improve viscosity in both types of compound.

For more information on "Dutch Boy" Stabilizers and Gelling Agents, write National Lead's Technical Staff.

Dutch Boy® CHEMICALS

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111 Broadway, New York 6, N. Y.

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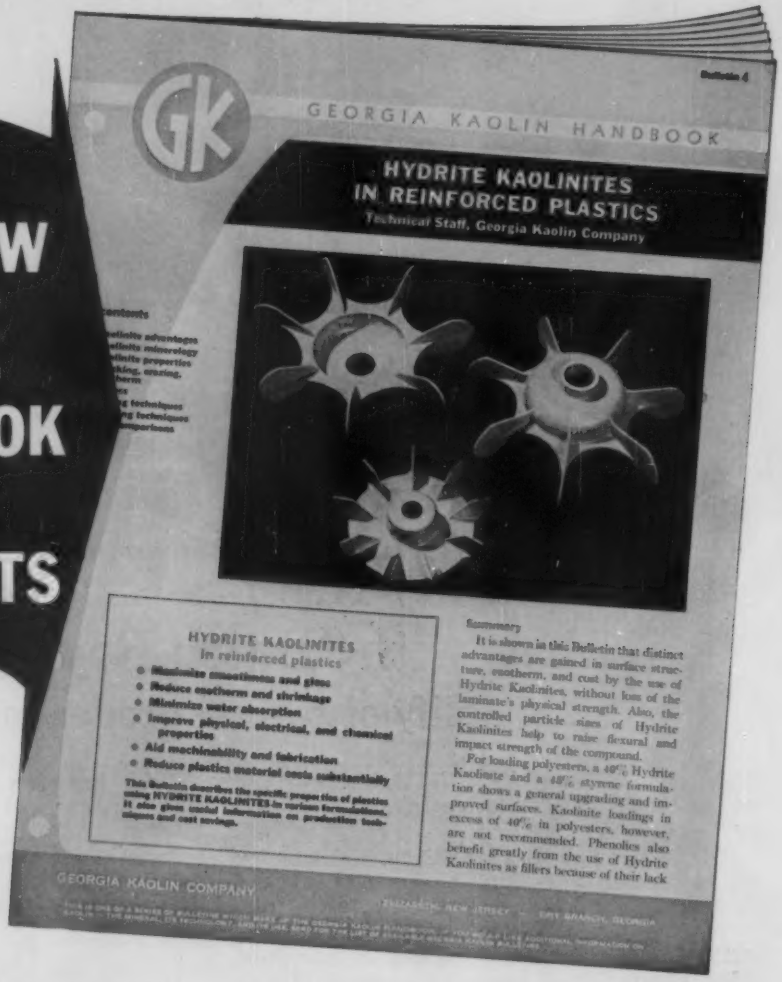
HOW HYDRITE KAOLINITES

improve properties and reduce cost of reinforced plastics

THIS NEW FREE HANDBOOK GIVES THE FACTS



Our new Bulletin 4, is packed with information regarding the effects of HYDRITE KAOLINITE FILLERS in reinforced plastics.

It tells how HYDRITE KAOLINITES maximize smoothness and gloss; reduce exotherm and shrinkage; minimize water absorption; improve physical, electrical and chemical properties; aid machinability and fabrication and reduce plastics material costs substantially.

The Bulletin describes the specific properties of plastics using HYDRITE KAOLINITES in various formulations. It also gives useful information on production techniques and cost savings.

Send for your free copy today.

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machines give you

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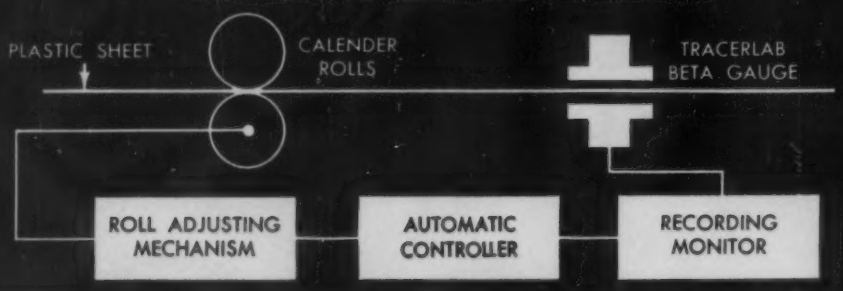
now . . . AUTOMATION IN PLASTIC SHEET PRODUCTION!



Here's how you can benefit with Tracerlab's new system of automatic control:

- **precise, fully automatic control of gauge**
- **faster, higher quality production — no "off gauge" stock**
- **complete, continuous automatic record-keeping**
- **minimum supervision and attention required**

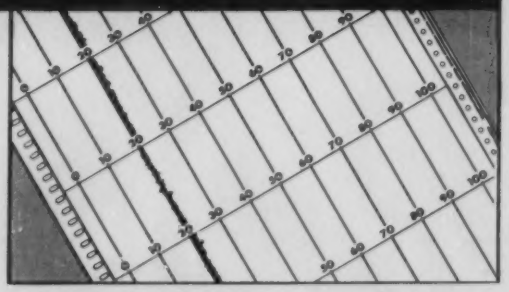
At last you can apply an automatic control system to the production of plain or embossed plastic sheet and reap the benefits of automation in *your* operations.

Tracerlab Beta Gauges and associated "feedback" correction and control equipment provide precise, continuous control to maintain the required thickness exactly, and eliminate costly, wasteful "off gauge" production. You do away with customer complaints and rebates due to off-spec gauge or yield.

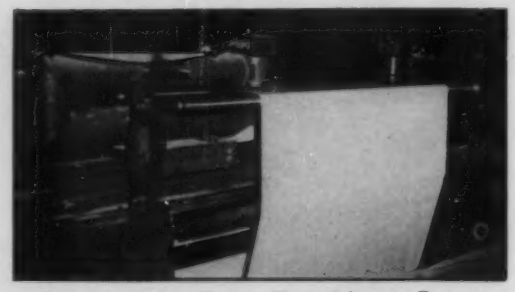
This Tracerlab equipment is *fully automatic* . . . needs almost no supervisory attention. And your machine operators are released for other, more productive work. To get a run started, you simply set the desired thickness on the control console, then forget about it. The Tracerlab system continuously scans the sheet and instantly and automatically applies corrections to the calender rolls whenever any "drift" occurs.

You eliminate shut-downs for manual gauging . . . get increased production of far higher quality sheet. In addition, the Tracerlab system maintains its own permanent record of production on each run and through each shift.

If you have a problem that involves control of sheet thickness *either plain or embossed*, it will pay you to investigate the advantages of Tracerlab Beta Gauging with automatic control — an application of nuclear energy that quickly pays for itself.



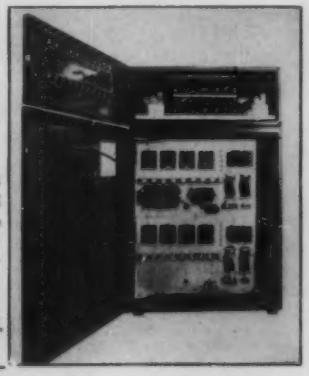
Record of production shows exceptional precision of thickness control you can achieve with Tracerlab equipment.



In a typical installation, Tracerlab Beta Gauges monitor both ends of wide plastic sheet.

How Tracerlab Automatic Beta Gauging Works

Tracerlab Beta Gauge continuously monitors sheet thickness. Reading from Beta Gauge is recorded on monitor. Thickness is compared to preset standard. Difference (if any) is applied to control mechanism which adjusts calender rolls automatically.



Accessory equipment provides for presetting thickness, recording, and continuous feedback correction and control.

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Tracerlab

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Petro-Tex is a "growth company" in every sense of the words... additional capacity, expanding product lines and aggressive application research.

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cut and slit-to-size.. excellent for

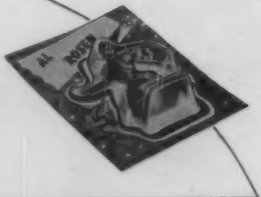
vacuum forming.

JODA crystal-clear cellulose-acetate sheets

and film ideally and economically suited for

blister and skin packaging.

Big League, Inc. has chosen a blister pack to display its many molded figures of baseball stars. This package was created and manufactured of JODA ACETATE by **PLASTIC ENTERPRISES,** College Point, L. I., N. Y.



An attractive counter display container for Yardley English Lavender talc powder and toilet water made of JODA crystal clear ACETATE by **PLAXALL,** Long Island City, New York

For further information and samples please contact

JOSEPH DAVIS PLASTICS COMPANY

Phone KEarny 2-0980-0981 JODA U.S.A. N. Y. BArclay 7-6421-6422

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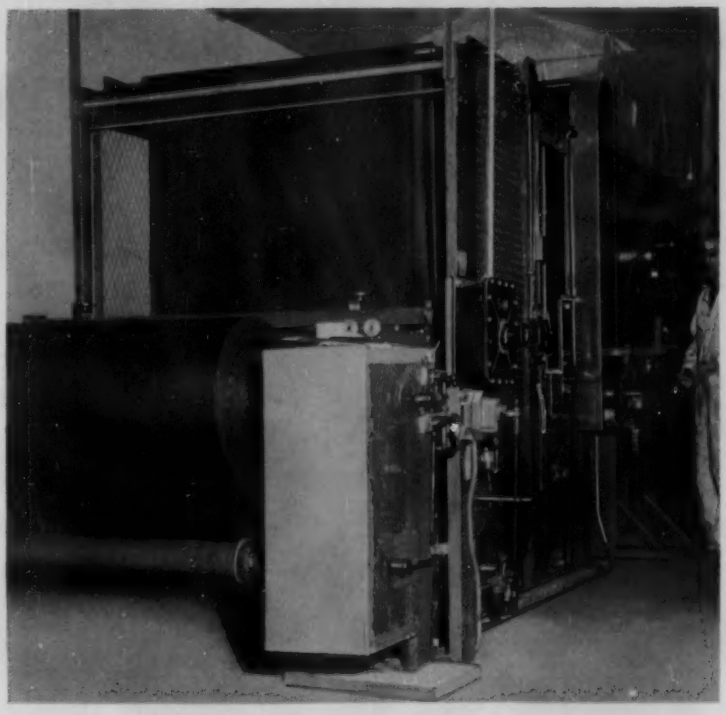
Sales Representatives Conveniently Located

laminates embosses and prints

in one operation



LEMBO LAMINATOR-EMBOSSER performs these 3 functions on all plastic film...

1 LAMINATES stretch back or drills *without adhesives!**

2 EMBOSSES

3 VALLEY PRINTS to closest tolerances

Compact, and costing only a fraction of mammoth equipment usually performing these jobs, it is especially practical for both short or long runs.

If your operation can benefit by fast, flexible equipment at considerably lower outlay and upkeep, you're invited to see the new LEMBO LAMINATOR-EMBOSSER in action. We will be happy to make experimental runs for you.

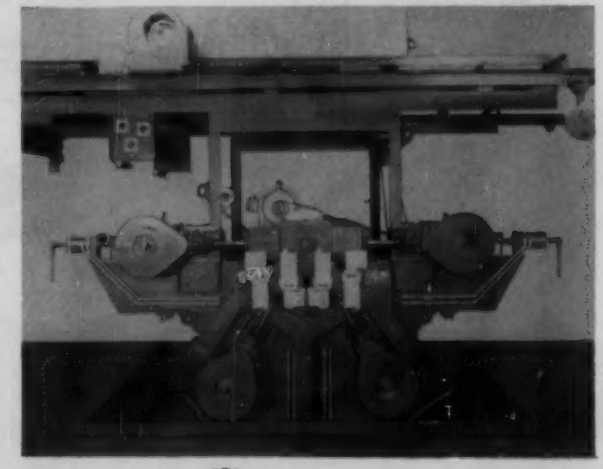
*Subject to proper film formulation and gauge.

LEMBO ROTOGRAVURE PRESSES

CUT DOWN SHUT DOWN! Hydraulic pressure on printing nips** permits operator to simultaneously back away all nips. Engraving rollers keep turning even while the printing machine is stopped. Ink doesn't dry on rollers. No wash-up needed. *Motorized Register Control* permits registry by operator from one position at panel board. Available, also, with electric eye.

Printers of all unsupported and supported plastic film prefer fast, quiet Lembo Rotogravure Presses for perfect, strain-free, in-register printing at speeds to 125 yards per minute. Shown right, 4-color – 52" between printing nips. Also, 6-color – 60" between nips.

**Optional equipment available at extra charge.



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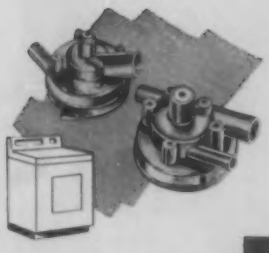
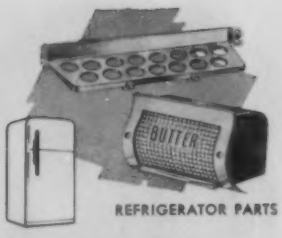
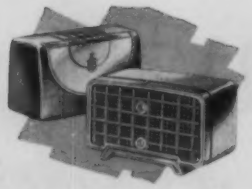
ROTOGRAVURE LEMBO PRESS LAMINATION



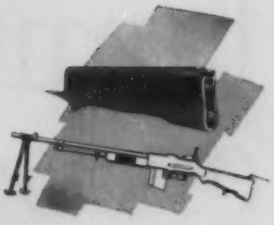
WASHER AND DRYER PARTS



REFRIGERATOR PARTS



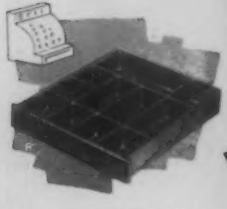
RADIO CABINETS



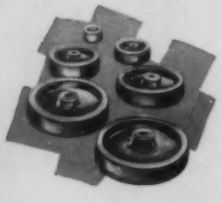
GOVERNMENT WORK

APPLIANCE HANDLES

VACUUM CLEANER NOZZLES

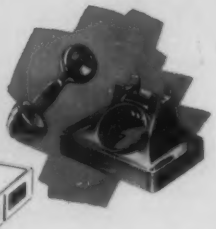


CASH REGISTER DRAWERS



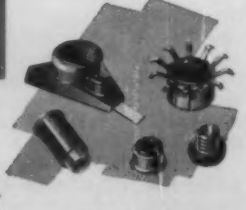
CASTERS

TEXTILE MACHINERY PARTS



TELEPHONE SETS

INDUSTRIAL GEARS



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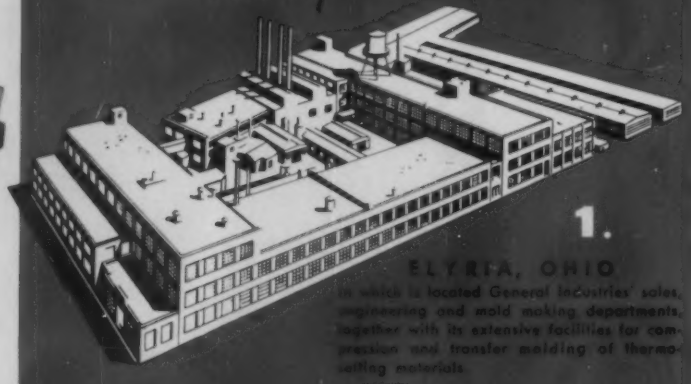

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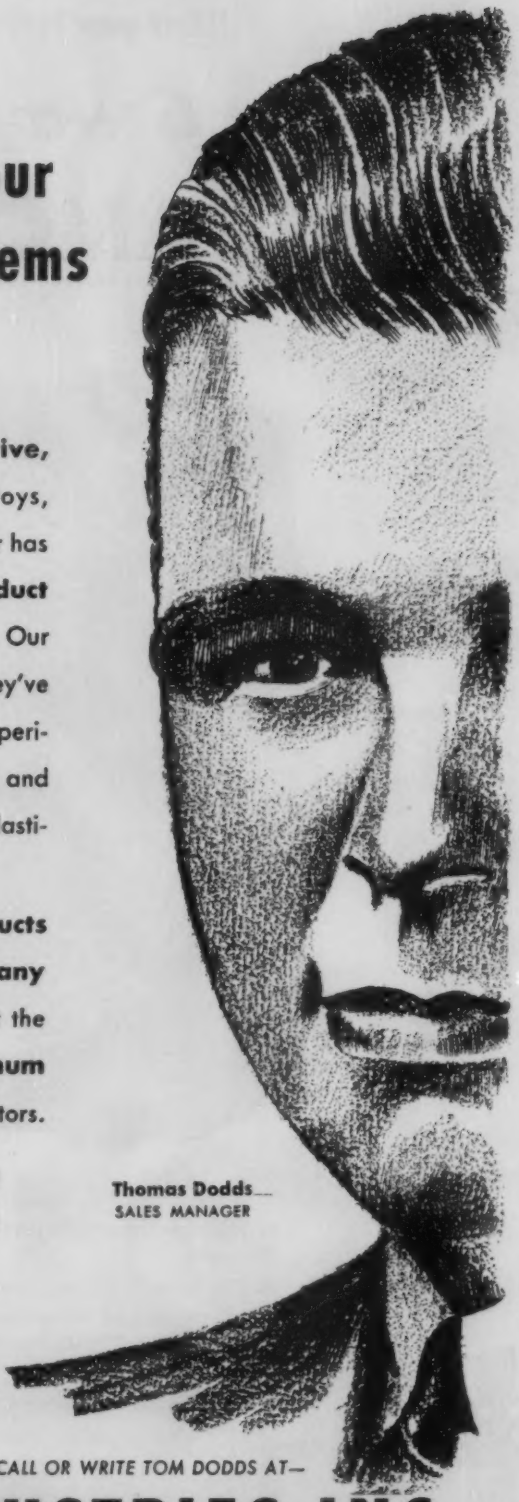

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U.S.I.

Vol. II, No. 2

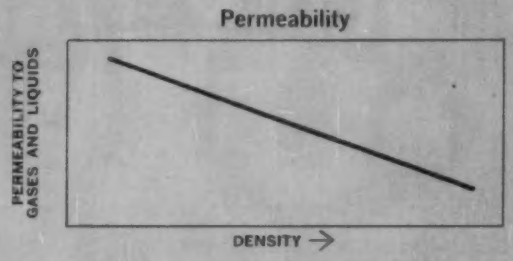
POLYETHYLENE PROCESSING TIPS

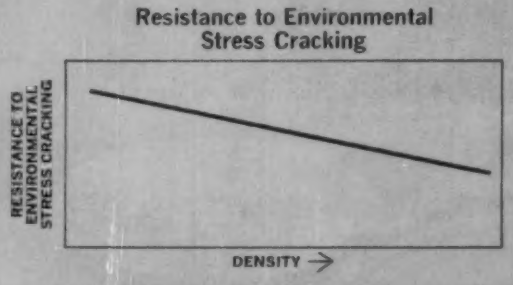
HOW RESIN DENSITY AFFECTS POLYETHYLENE PROPERTIES

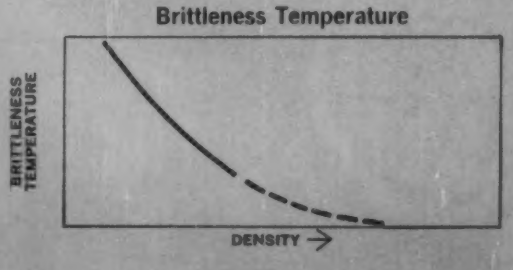
The *density* of a polyethylene is one of three basic characteristics which determine the properties of a processed part. The other two basic characteristics are *molecular weight* and *molecular weight distribution*. Relationships among the three were discussed in Tips, Vol. 2, No. 1 (reprints are available).

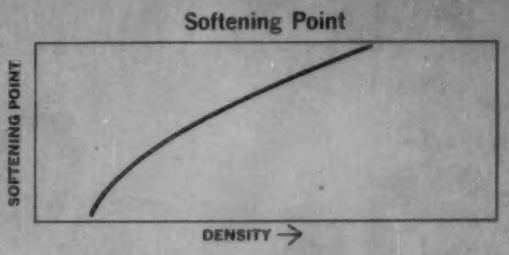
Polyethylene density can range from 0.910 to 0.965. The graphs below indicate what happens to certain properties as density of the resin increases, assuming the other two basic characteristics do not change.

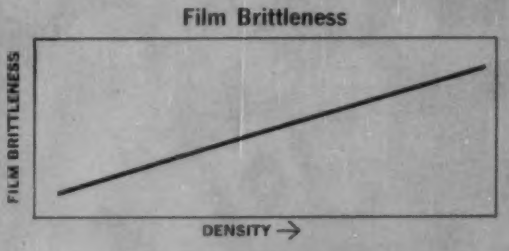
It must be remembered, though, that these graphs do not give the entire story. Molecular weight and molecular weight distribution are often different in resins of different densities, so the effects of all three must be taken into consideration if the end properties are to be predicted. The effects of these other characteristics on end properties will be discussed in future issues of "U.S.I. Polyethylene Processing Tips".

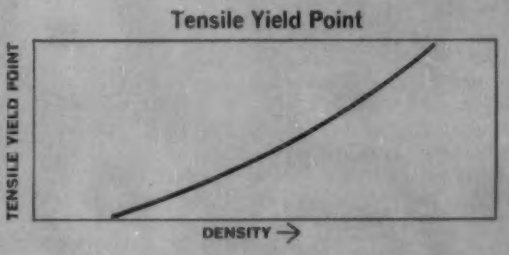


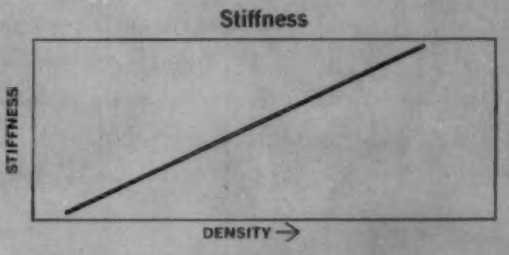












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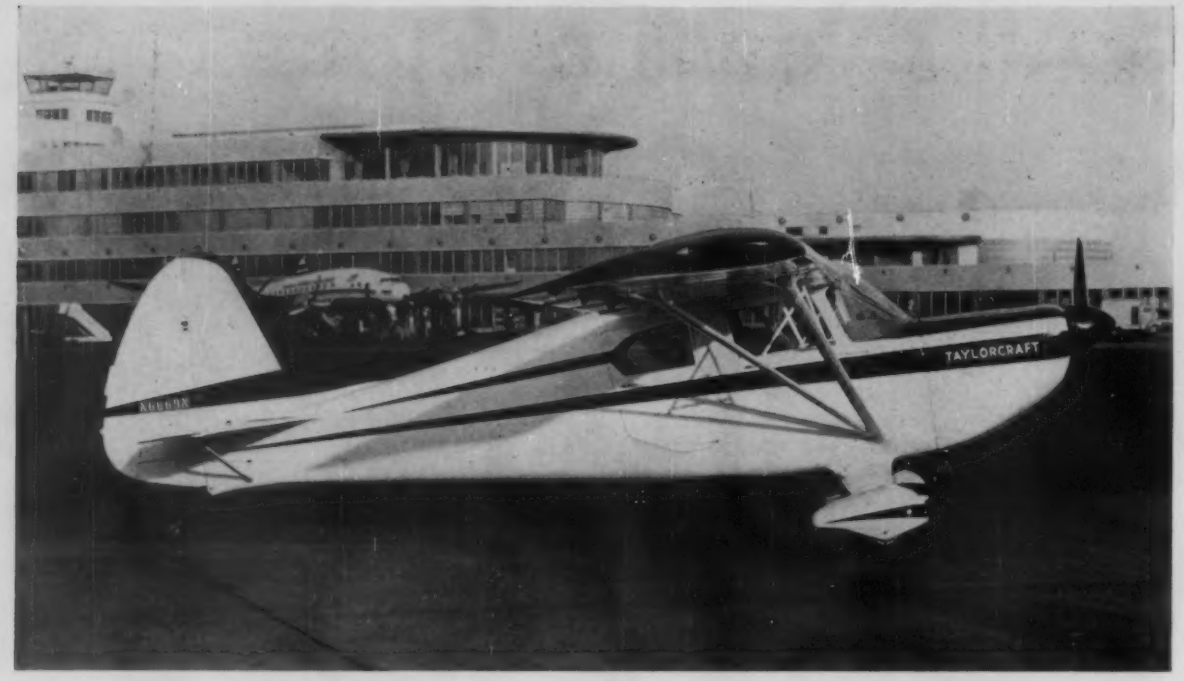

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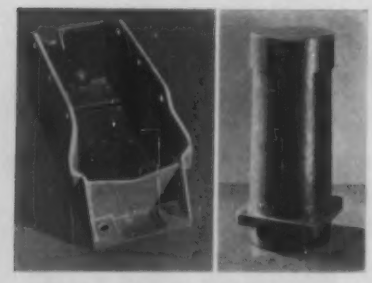

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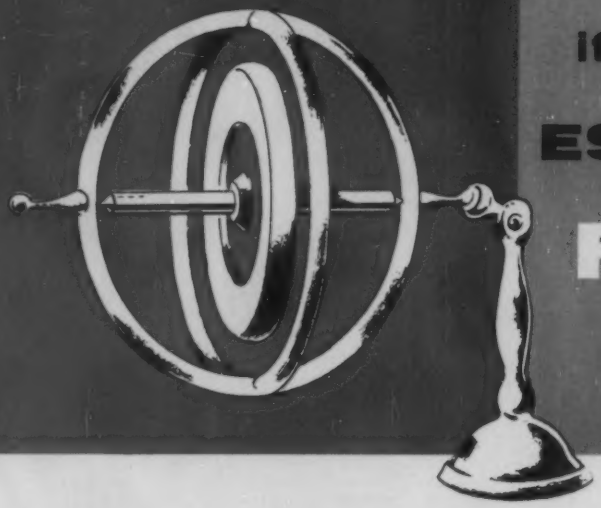

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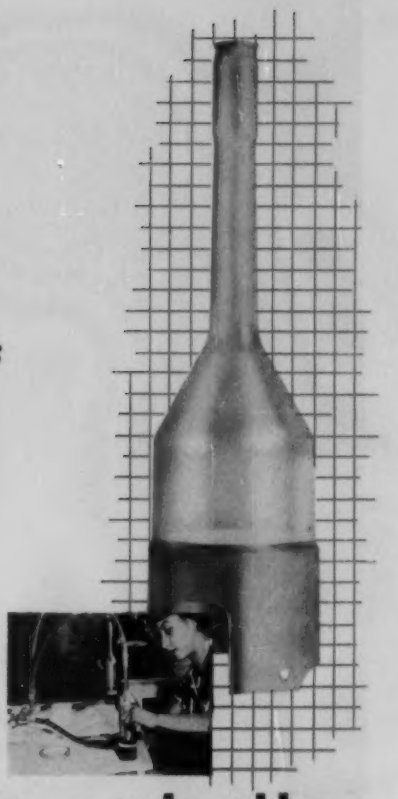

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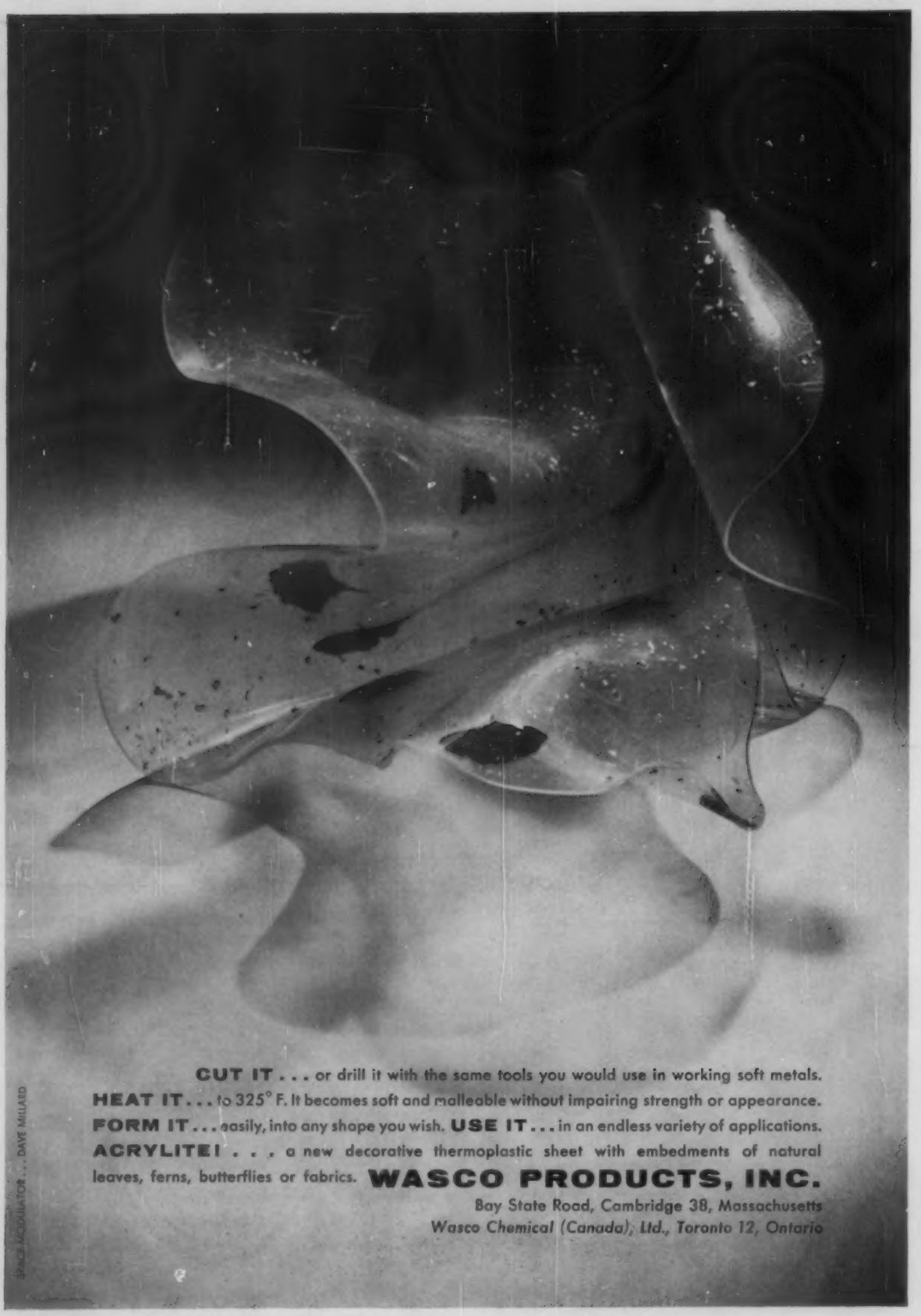

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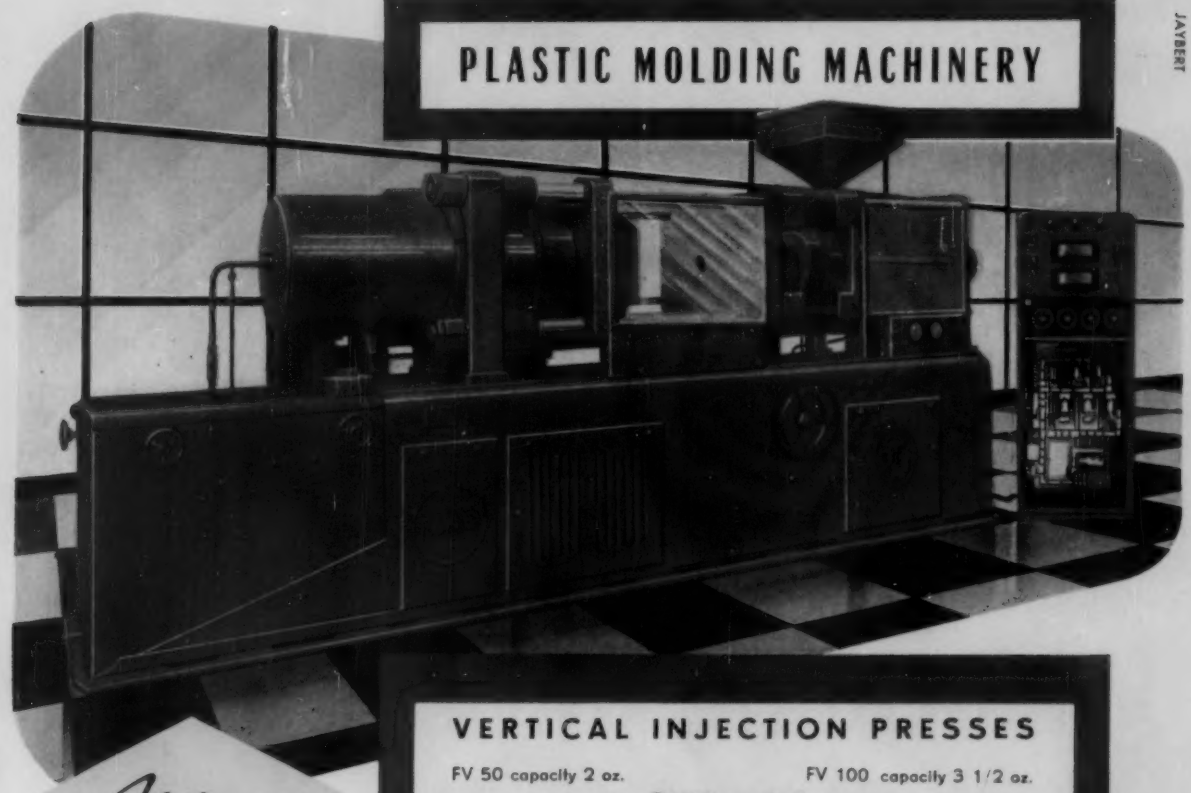

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A considerable share of our production of saturating papers goes to the manufacturers of laminated parts used in a wide variety of industries.

The entire facilities of our mill are now devoted to the making of saturating paper for laminated plastics and other absorbent specialties. A competent staff of technicians is at the service of our customers in working to their specifications or in the development of new grades and colors. Inquiries are invited.

THE WRENN PAPER COMPANY

Established in 1858

MIDDLETOWN, OHIO

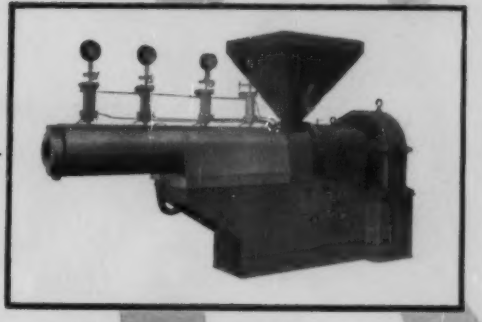
Egan Extruders

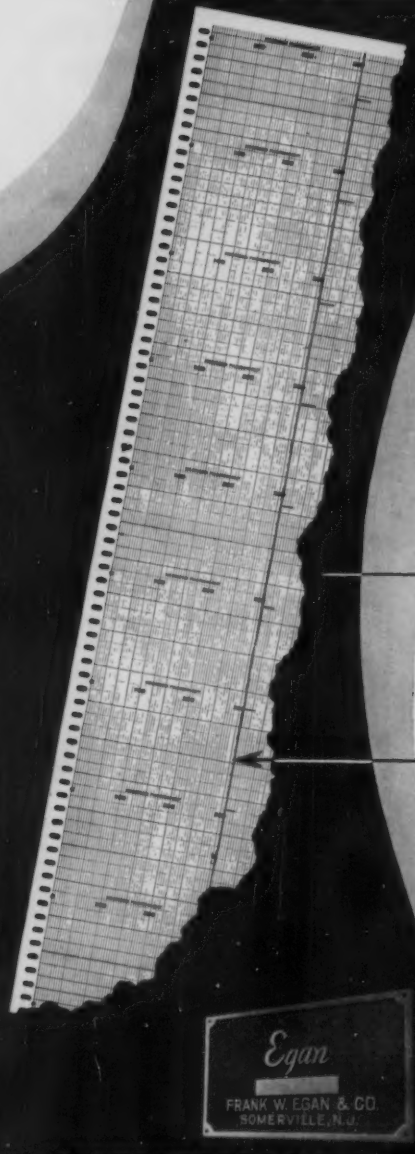
with "WILLERT VAPOR PRESSURE COOLING"*

PRODUCE

Close Tolerance Extrusions

EASIER AND FASTER!





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Indicated and recorded during a typical day's production run—not a carefully controlled laboratory test.

Egan extruders are the only extruders available with an automatic temperature balancing system which *also provides* a quick cooling feature—*without pumps, blowers, or compressors.*

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Designers and Builders of Machinery for the Paper Converting and Plastics Industries

Cable Address: "EGANCO" — Somerville, N.J.

Representative: MEXICO, D. F. — M. H. Gottfried, Avenida 16 De Septiembre, No. 10. **Licensees:** GREAT BRITAIN — Bone Bros. Ltd., Wembley, Middlesex. FRANCE — Achard-Picard, Remy & Cie, 36 Rue d'Enghien Xe, Paris. ITALY— Emanuel & Ing. Lee Campagnano, Via Borromei 1 B/7, Milano. GERMANY— ER-WE-PA, Erkrath, bei Dusseldorf.

Manufacturers of quality papers specify Du Pont TI-PURE® *titanium dioxide pigment to add brightness and opacity . . . just as makers of quality printing inks specify Du Pont Pigment Colors for fine reproduction. Reprints of this illustration, suitable for framing, are available on request from your Du Pont Pigments salesman.*

Du Pont Pigments add beauty...practicality...versatility

NATURE'S COLORS ARE RIVALED BY DU PONT PIGMENTS

The brilliance of a butterfly captured in crock- and bleed-resistant colors

MOST of nature's brilliant colors can be duplicated. But, in plastics, the working properties and processing characteristics of pigment colors are also extremely important. And so is performance. Because Du Pont Pigments offer plastic manufacturers a combination of these properties, they are widely accepted for use in plastic and rubber applications.

Consider Du Pont "Monastral"® Greens and Blues, for example. These pigments offer superior resistance to crocking and migration in all shades. In addition, they are the most lightfast and chemical-resistant of all organic pigments—they also have outstanding resistance to heat. "Watchung" Reds also have outstanding resistance to migration, heat and crocking.

But that's just part of the story. The pigments you use must disperse easily . . . assure you of ease in processing and dependable performance in finished products.

Call on your Du Pont Pigments representative to assist you in your pigmenting problems. Du Pont has an extensive background of technical experience in the plastic and rubber fields. E. I. du Pont de Nemours & Co. (Inc.), Pigments Department, Wilmington 98, Delaware.

• • •

These high-quality Du Pont Pigments will give you the colors and properties you require.

Green-Gold —Durable Organic Yellow	Chrome Yellows
MONASTRAL® Blues and Greens	Shading Yellow
"Ramapo" Blues and Greens	TI-PURE® Titanium Dioxide
Molybdate Oranges	Benzidine Yellow
	"Watchung" Reds

Frequent checks confirm the high batch-to-batch color uniformity and dispersion characteristics of Du Pont Pigments. Here, a pre-production sample of vinyl sheeting, containing 0.1% "Monastral" Blue B BT-380-D and 1.0% "Ti-Pure" titanium dioxide, is compared with a specification color standard. Du Pont "Monastral" Pigments are widely used in many plastics products requiring top resistance to light, heat and migration.

PIGMENTS DEPARTMENT

DU PONT

BETTER THINGS FOR BETTER LIVING . . . *THROUGH CHEMISTRY*

to fine products everywhere

We have a house to put in order...

WE HAVE A HOUSE to put in order . . . and it's the house where America lives.

Of our country's many million homes, more than 1 out of every 10 are out-and-out slums. Nearly one-half of all American dwellings are in poor to "fair" condition, and urgently need basic repairs.

Something *must* be done—both to correct the slums of today and *prevent* the slums of tomorrow.

How do slums start? Usually just one house starts to slide downhill and soon a whole block changes. Pride is lost. Other houses are neglected, decay spreads.

So the 20 million homes in need of basic repair and improvements deserve equal attention. The time to stop the spreading blight of slums is *before it starts*.

What's your stake in stopping slums?

If you think your town is different, just look around you . . . If you think slums only affect persons who live in them, think again.

Slums raise taxes and lower property values of the whole town. They raise rates of crime, delinquency and disease. *Everyone* has a real stake in stopping slums. And *that includes you as a businessman.*

Your firm is certainly dependent on the welfare of the community where you do business. But it's more than good business—it's good citizenship to take part in efforts aimed at civic improvements. It's the *responsibility* of every business.

What can your firm do? The answer to America's housing problems starts with individuals. But to roll back slums is such a big job it's going to take more than individual effort. It will need the cooperation of your business and many others.

Some slums should be torn down and a fresh start made. Others can be remodeled and made to conform to better living standards. So it is up to you to support every sound program which seeks adequate housing for all our people.

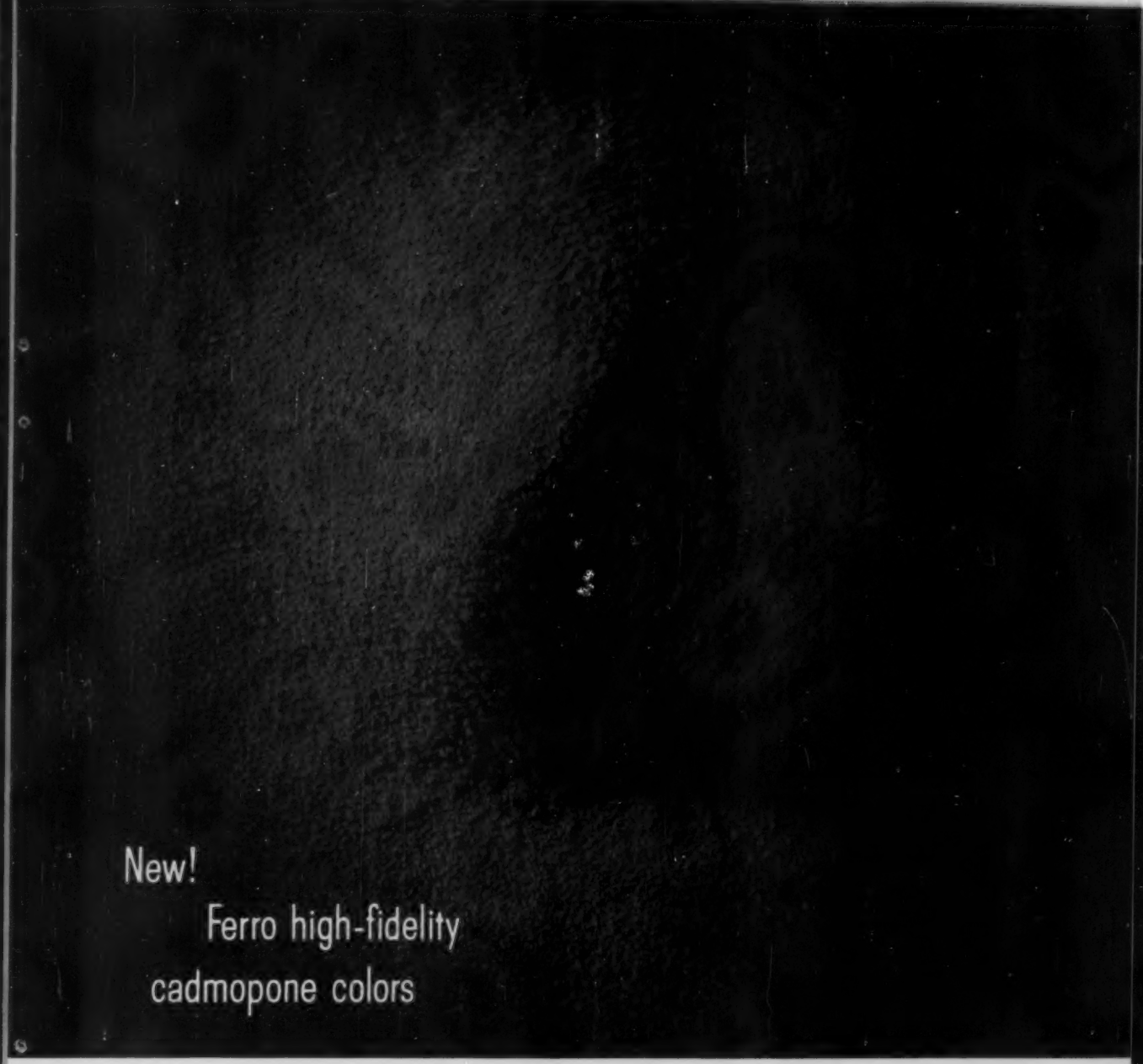
New help is now available

There is a new national, non-profit organization called A.C.T.I.O.N.—The American Council To Improve Our Neighborhoods—which is designed to help all individuals or groups interested in putting America's house in order.

Send for a free copy of "ACTION." It explains what A.C.T.I.O.N. is and proposes to do. It lists booklets, research, check-lists, and other material which can help you. Address P. O. Box 500, Radio City Station, New York 20, N. Y.

ACTION

American **C**ouncil **T**o **I**mprove **O**ur **N**eighborhoods



Easier to disperse! Excellent heat and light stability!

Now, Ferro has developed a new type of reduced cadmium pigment that is lighter and fluffier for easier dispersion. New Ferro CADMOPONES are highly resistant to heat, light, acids and alkalies. They give you permanent, nonbleeding and fade-resistant colors for all plastic materials.

CADMOPONE colors are perfect for dry coloring clear resins in your own plant. This simple process eliminates waste, cuts the cost of raw materials and helps you give faster delivery on special jobs. Ferro can supply you with technical data and suggestions for dry coloring the plastics you use.

If you use red, orange or maroon in your production, you can save time and money with New Ferro CADMOPONE colors. Their faster dispersion and stability cut rejects and improve quality. Write today for color chart and samples!

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Color Division
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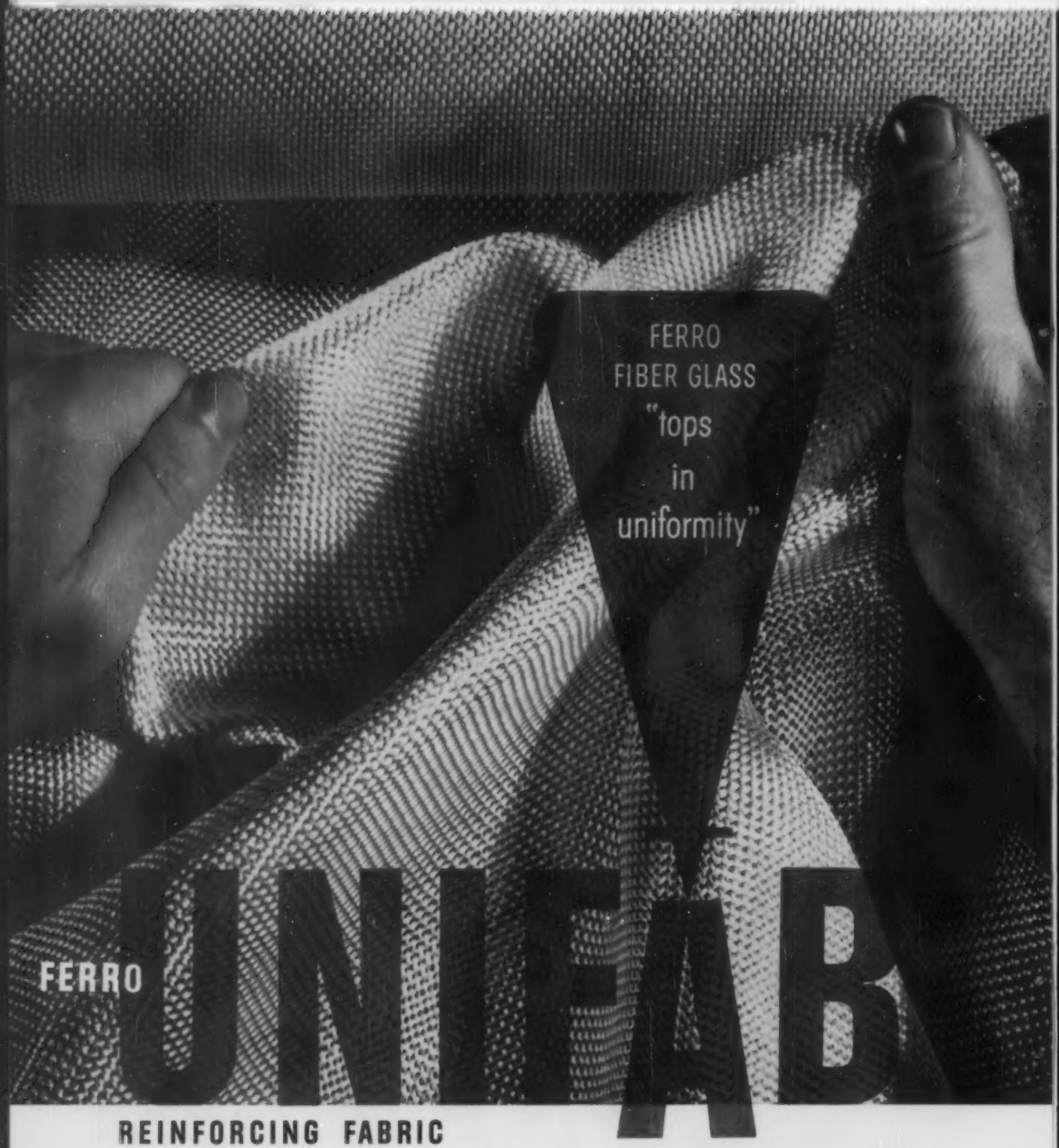
Foreign plants in Argentina, Australia, Brazil, Chile, England, France, Holland, Japan, Mexico, South Africa

F-11886 Orange | F-11887 Orange-Red | F-11888 Red | F-11571 Maroon



REINFORCING FABRIC

Newest member of the Ferro family of Fiber Glass products, UNIFAB provides the ultimate in plastic reinforcement. Made to high quality standards and checked at every stage of production, you'll find UNIFAB fabrics unusually uniform in weight, thickness and weave. Write for samples, specifications and prices.

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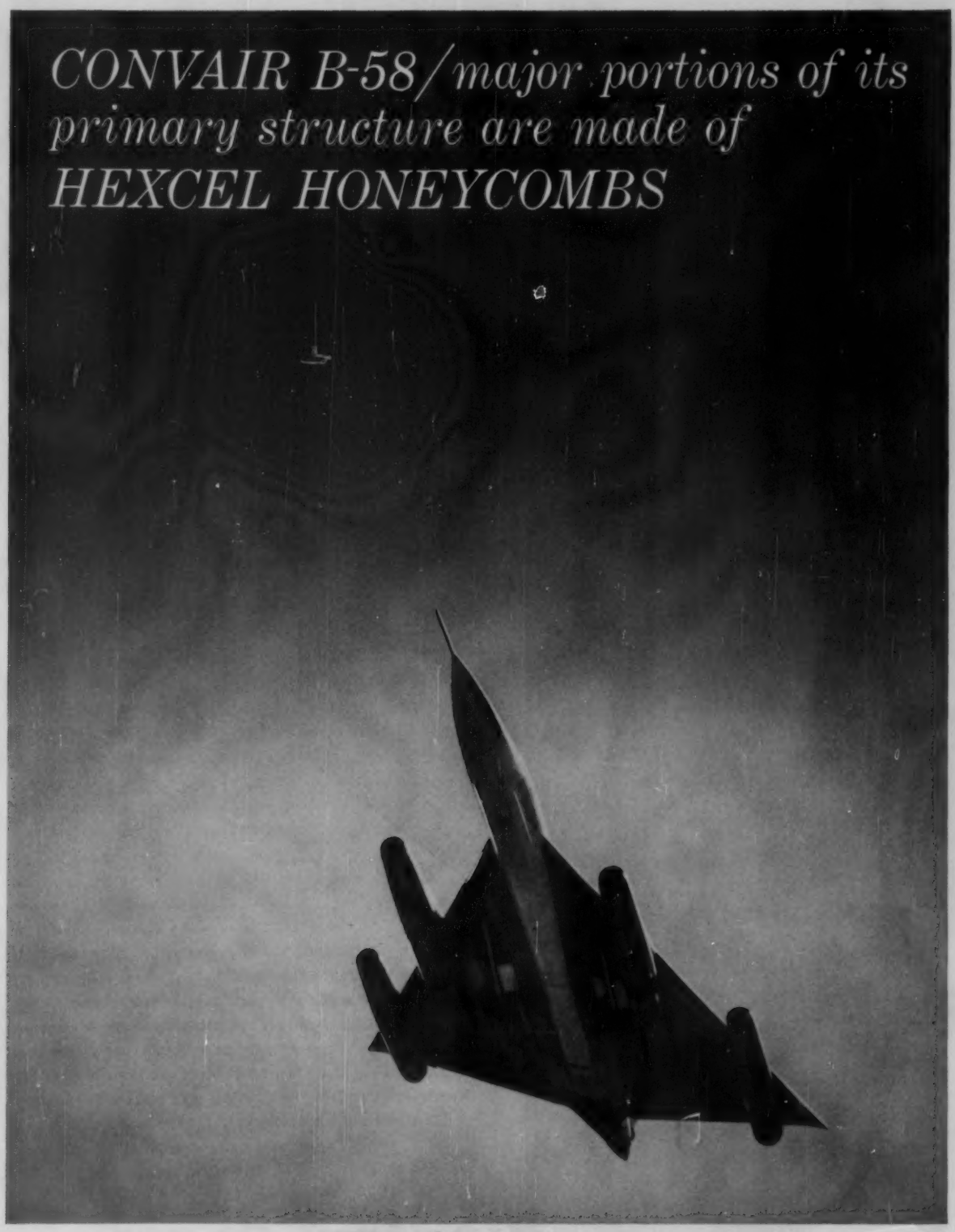
CONVAIR B-58/major portions of its primary structure are made of HEXCEL HONEYCOMBS



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America's leading producer of honeycomb core materials
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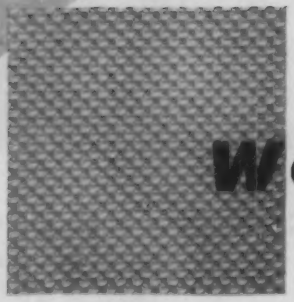
Light but tough!

modern protection based on WELKOTE

This 10′ x 14′ Welkote based tarp is an easy load for one man.

Welkote is at the very heart of the big change in protective coverings. On trucks and railroads, on playing fields, construction sites and oil fields . . . wherever dependable, lightweight protection is needed, you find more and more tarpaulins, tents and covers based on this Wellington Sears base fabric for neoprene and vinyl coatings. Tough filament nylon Welkote teams up perfectly with vinyl and neoprene because it was specifically engineered for them. The finished Welkote-based product, when properly coated and fabricated, is amazingly light, yet strong beyond belief. Its remarkable tear strength and resistance to water, wear and weather, are already setting new long-term economy standards in many industries. Further, Welkote-based materials are easier to transport and handle (see picture above). Welkote is widely specified by coaters. Supplied by Wellington Sears in three basic weights, it is one of many fabrics we engineer for the coating industry—and one of a long list provided to all industries for over a century. This extensive experience is yours to work with in all our base fabrics, available for every coating use at Wellington Sears. For illustrated booklet, write Dept. K-3.



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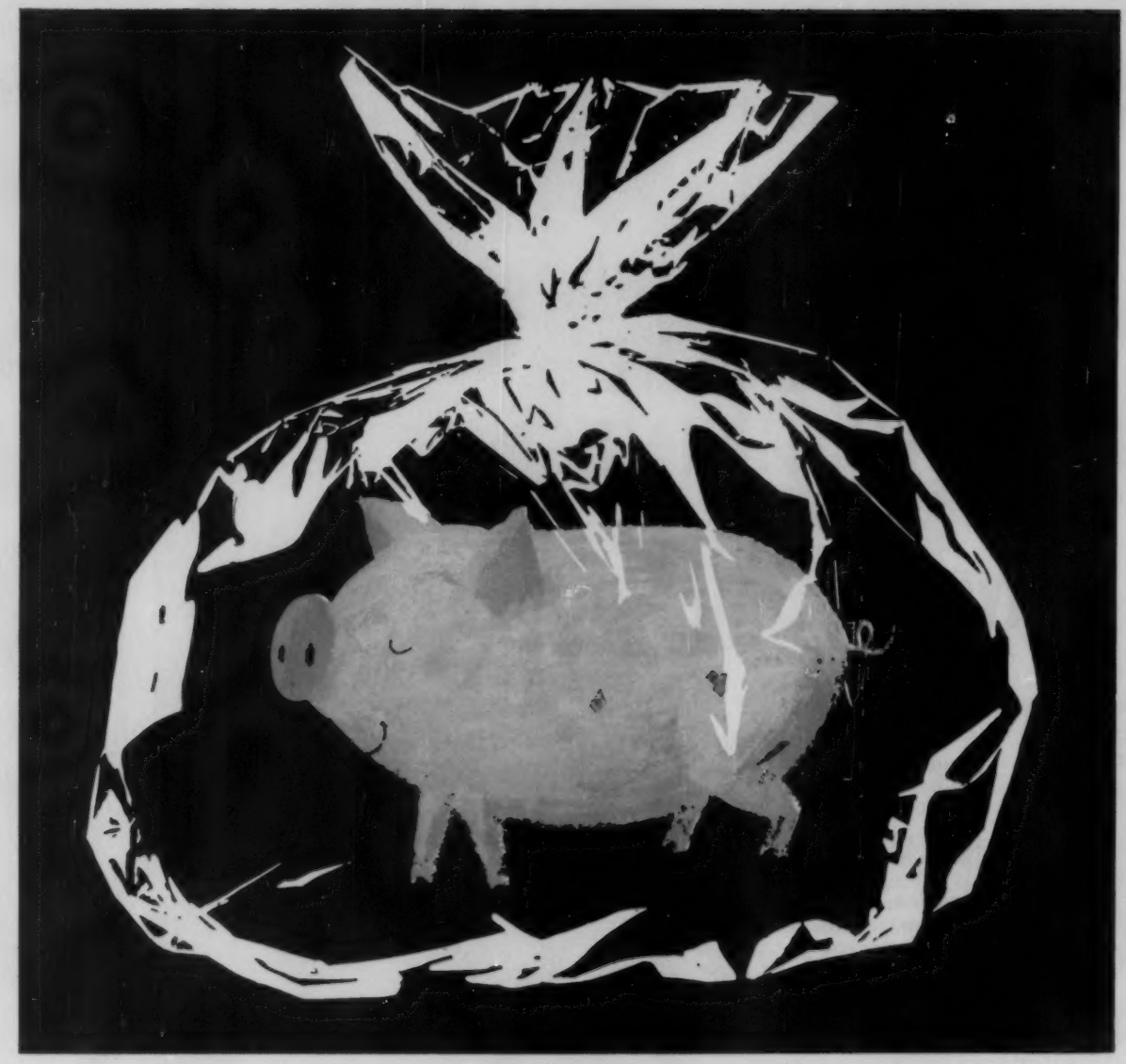

Happy home for packaged foods

. . . made with Paraplex G-62 plasticizer*

Vinyl films made with PARAPLEX® G-62 plasticizer protect the flavor and appetizing appearance of all kinds of packaged foods—meats, poultry, fish, lard, fats, oils, margarine, frozen foods, as well as fresh fruits and vegetables.

They're all safe with PARAPLEX G-62 . . . because this plasticizer is non-toxic, low in odor and taste. In addition, PARAPLEX G-62 is an effective stabilizer for all chlorinated polymers—films resist discoloration during high temperature processing in milling, extruding and calendering.

**Acceptable to the* FOOD AND DRUG ADMINISTRATION AND THE MEAT INSPECTION BRANCH OF THE U. S. DEPARTMENT OF AGRICULTURE.

For more information on *all* of the plasticizers produced by Rohm & Haas Company, write for *What You Should Know About* PARAPLEX *and* MONOPLEX® *Plasticizers.*

Chemicals for Industry

ROHM & HAAS COMPANY

THE RESINOUS PRODUCTS DIVISION

Washington Square, Philadelphia 5, Pa.

Representatives in principal foreign countries

Who knows about SPECIAL ADHESIVES for MYLAR* laminations?

Mylar adhesives have to be as versatile as the famous polyester film itself. Bond strength, clarity, resistance to light, even flow for machineability, affinity for a variety of surfaces . . . all are features needing careful control.

At Angier Adhesives, hundreds of laboratory and test hours have been focused on Mylar adhesives alone. There is an Angier adhesive for laminating Mylar to itself or to most other materials . . . to sheet metal as a lining . . . to aluminum foil as a vapor barrier . . . to leather as a surface protective . . . to vinyl film for decorative purposes . . . to asbestos paper for wire insulation, etc.

Who knows about Mylar adhesives? We ought to have most of the answers you need. Try us.

*MYLAR is DuPont's registered trademark for its brand of polyester film.

Write for more information on Angier's SB-6300 Mylar Adhesive Series.

For EVERY Industry: Latest developments in adhesives for Sandwich Panel Construction, Vinyl Film Bonding, also Rubber, Latex and Resin Cements, Pressure Sensitive Cements, Flocking Cements, Laminants, Sealants, Tie Coats and Resin Emulsions.

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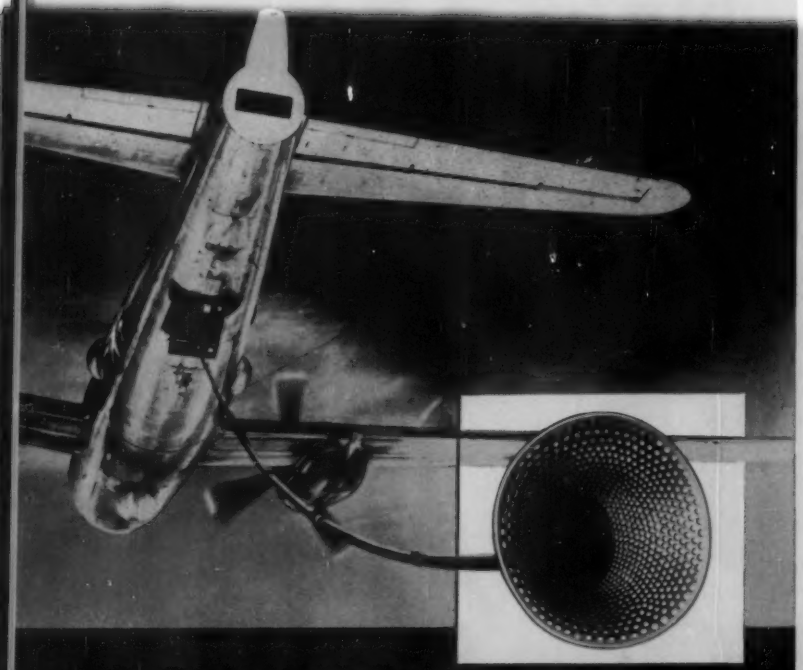

FLYING GAS STATION! Drogues for refueling aircraft in flight show how Araldite Epoxy-glass cloth laminates combine high strength/weight ratios with excellent chemical resistance.
Hampden Brass & Aluminum Co.
Flight Refueling Co., Inc.

ARMOR FOR BOATS! Here an Araldite Epoxy formulation is used with glass cloth for the armor-plating of small boats. The same combination can be used for the rapid, inexpensive repair of splits and gouges in boat hulls.
Cordo Chemical Corporation

from gas stations in the sky... to armor for small boats...

LAMINATING WITH ARALDITE® EPOXIES SPEEDS UP PRODUCTION.

EASILY PROTOTYPED...
LOW COST MOLDS...
FAST CURING!

Is your problem the production of prototypes for design approval? Is it mass production laminates . . . is it custom work? Whatever the problem, Araldite Epoxies may help you.

Their unique combination of extremely low shrinkage (from less than 0.5% to 2%), dimensional stability, rapid curing (in minutes with heat), and excellent adhesion, are providing answers daily to design and production needs.

Molds, too, can be made inexpensively from wood, plaster or metal. Or if your interests are tooling, electrical, adhesives or coatings, it would pay you to investigate Araldite Epoxies.

Why not now? The coupon is for your convenience.

CIBA

"FIRST IN EPOXIES"

CIBA's Technical Services, including complete and up-to-date bulletins on the properties and uses of Araldite Epoxy Resins, are always available for the solution of your Epoxy problems. For full information, mail coupon or write . . .

CIBA produces basic resins only, to be formulated for intermediate and end uses.

CIBA COMPANY INC., Plastics Division MP-3
Kimberton, Pennsylvania

Please send me full information on CIBA Epoxy Resins for
☐ Tooling ☐ Structural Laminates ☐ General
☐ Electrical ☐ Hi-Strength Adhesives ☐ Surface Coatings ☐ Plastic Body Solders

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For Under $1,000, You Can Develop and Produce Small Plastic Items with

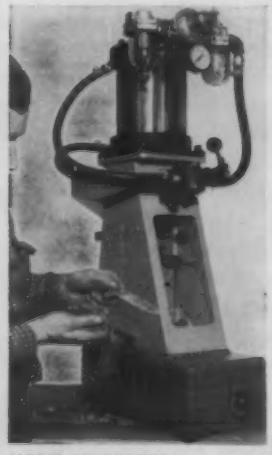
MINI-JECTOR

TRADE MARK

PLASTIC INJECTION MOLDING MACHINES

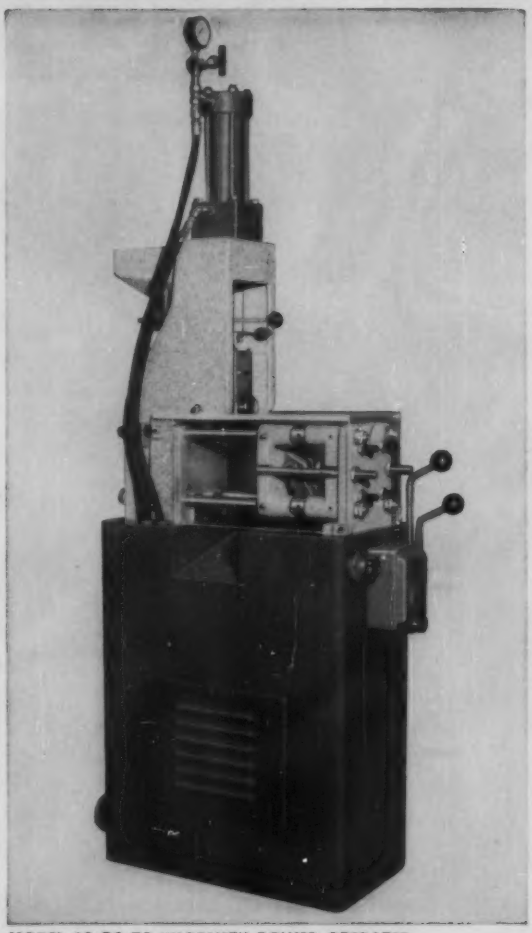
Users Report New Economy, Efficiency in Development, Samples and Production of ⅓ oz. to 1 oz. Injection Molded Products

Unsurpassed *flexibility!* That's how MINI-JECTOR saves you important manhours and capital expenditures. Discard expensive methods of developing small plastic items. Avoid big press "high-per-piece costs". Eliminate high tooling charges. At only a *bare fraction* of former time, trouble and money, MINI-JECTOR develops the item, then follows-up with quick-thousands of perfect samples, and finally, steady, moderate production. Simple to operate. Molds unlimited variety of small items (⅓ oz. to 1 oz.) in all thermo-plastic materials, including Nylon. MINI-JECTOR in your plant will pay for itself many times in *savings alone.*



MODEL 45 "WASP" ¾ oz. capacity air-operated Mini-Jector . . . fast and economical. 6" air cylinder operates ram . . . 40 to 150 pounds of air pressure required depending on type of plastic used and product being molded. Material hopper capacity 4 pounds.

MODEL 50 "WASP" a new Mini-Jector . . . capacity 1/3 oz. to 1 OUNCE at pressures up to 30,000 PSI. This is an ideal model for precision insert work with any type of plastic. Hydraulically operated.



MODEL 60-PC 75 "HORNET" POWER OPERATED LEVER CONTROLLED. Mold size 6" x 5" x 5⅛"

Newest of the time-tested, performance-proved MINI-JECTORS offers many exclusive features. Finest 4-tie rod construction. Cyl. and ram quickly interchangeable. Simple tooling. Parting-line sprued molds. Molds bolt to platens, cells removable. Molded part ejection, cavity-cell push-out are part of mold. Preferred for larger area items or production runs. Simple to operate. ⅓ oz. to 1 oz. cap. Up to 30,000 p.s.i. on material. ¾ oz. model hydraulically operated (Vickers), complete, ready to operate, under $2,000.

EVERY DAY THOUSANDS OF ITEMS ARE BEING PRODUCED PROFITABLY ON MINI-JECTORS

Bring your problems to Newbury! Our pilot plant can help you solve your tricky, small-item (up to 1 oz.) development and production difficulties.

WRITE TODAY . . . for literature telling how Mini-Jector may help solve your injection molding problems, to . . .

NEWBURY INDUSTRIES, Route 87, Newbury, Ohio

"Specializing in the Production and Development of Plastic Injection Molding Machines up to one ounce capacity."

For full information, mail coupon or write . . .
CIBA produces basic resins only, to be formulated for intermediate and end uses.
ADDRESS
CITY STATE

"SUPER DYLAN* plastic motor shield has meant substantial sales increases"

. . . . . says R. H. SAWYER, *Lombard Governor Corp., Ashland, Mass.*

"Pioneering in lightweight precision-made chain saws, we feel we have helped change the woodcutting industry from a hand to a power operation," states Mr. Sawyer, Works Manager of the Lombard Corporation. "Lightness is so important in *all* component units that we use magnesium in some parts of the Lombard Chain Saw.

"In designing the motor shield, we tested many metals and plastics and decided that only Koppers SUPER DYLAN polyethylene offered the necessary strength, lightness and colorability coupled with a decided cost advantage. In use, the SUPER DYLAN shield weighs just six ounces including three metal screw inserts, is hard to the touch, protects the upper parts of the motor and gas tank, yet is flexible enough not to shatter or dent in rough use. And, of course, it's impervious to the weather. The shield's attractive design and brilliant red color have been real eye-catchers when our Lombard Chain Saw is on display in crowded stores. Its brightness acts like a stoplight for store traffic. We feel that SUPER DYLAN helps us maintain our claim of high quality and low price."

Have you thought of using a Koppers Plastic to help maintain a reputation of quality for *your* product? Many manufacturers are using Koppers SUPER DYLAN, DYLAN® polyethylene, DYLITE® expandable polystyrene or DYLENE® polystyrene to make their products more practical, marketable and profitable. For more information, write to Koppers Company, Inc., Dept. MP-37, Chemical Division, Pittsburgh 19, Pennsylvania.

**Koppers Trademark*

KOPPERS

KOPPERS PLASTICS

Sales Offices: PITTSBURGH • NEW YORK • BOSTON • PHILADELPHIA • ATLANTA • CHICAGO • DETROIT • HOUSTON • LOS ANGELES • SAN FRANCISCO

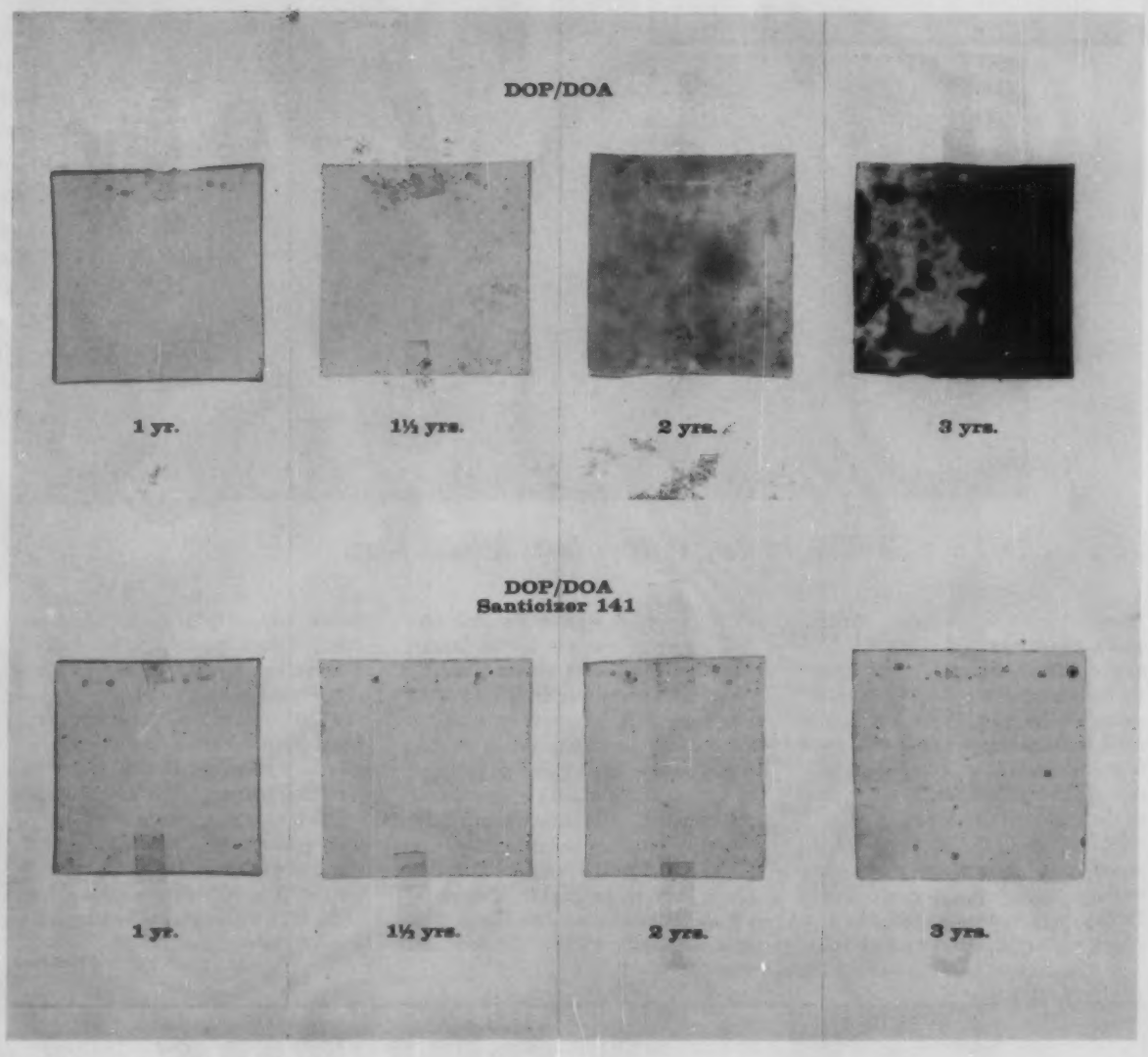
In Canada: Dominion Anilines and Chemicals Ltd., Toronto, Ontario

Low-cost light stability

Across-the-board approval for non-toxicity

Higher tear strength and flame retardance

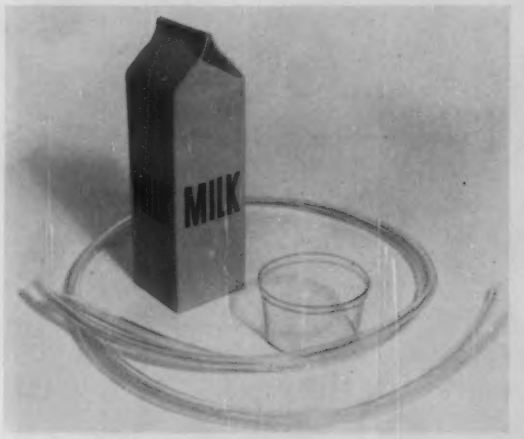
ONLY SANTICIZER 141 GIVES

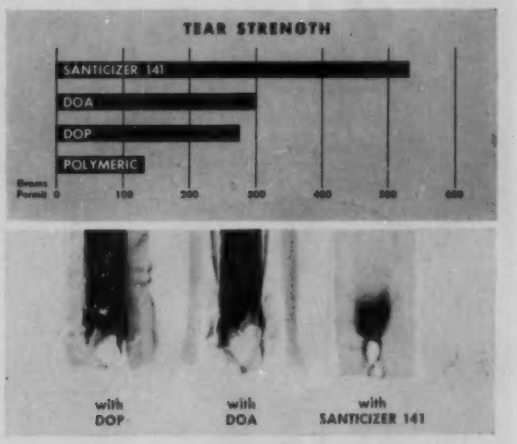


1. Low-cost light stability

These samples from a 3-year outdoor exposure study show the excellent light stability that is inherent in Santicizer 141. Control compounds (40-mil sheeting) plasticized with a blend of DOP and DOA began to fail in slightly over one year. Experimental samples in which five parts of Santicizer 141 replaced five parts of DOP show no visible deterioration even after two years of severe St. Louis climatic conditions—with only slight degradation after three years. Yet Santicizer 141 is a low-cost primary plasticizer!

YOU ALL THESE ADVANTAGES





2. Across-the-board approval for non-toxicity

If you're interested in the food packaging, tubing, and surgical supplies market, here's a valuable fact: Santicizer 141 meets the requirements of both the Food and Drug Administration and the Bureau of Animal Industry. Because Santicizer 141 has this across-the-board approval, you can use it for food packaging and plastic products intended for close contact with animal or human bodies.

3. Higher tear strength and flame retardance

Films plasticized with Santicizer 141 may have as much as *double* the tear strength of those plasticized with straight DOP. Santicizer 141 also imparts superior low-temperature flexibility, resistance to embrittlement on aging. And it has excellent flame-retarding properties: flame-out time is only three seconds for polyvinyl chloride plasticized with Santicizer 141 at 50 parts per 100 parts of resin.

WANT TO IMPROVE ANY OF THESE PRODUCTS?

To improve the light stability of curtains, floor tile, films . . .

To improve the non-toxicity of plastic surgical supplies, tubing, food wrappings and containers . . .

To improve the tear resistance and flame retardance of belting, tapes, upholstery, rain wear . . .

Our Technical Service Department will help you test Santicizer 141 in your operation. Monsanto supplies almost FIFTY different plasticizers of SEVEN basic types. Call on Monsanto for one-stop service, mixed bulk shipments at bulk prices, and expert technical advice.

MONSANTO CHEMICAL COMPANY
Organic Chemicals Division
Dept. PL-5, Box 478, St. Louis 1, Mo.

With no vested interest in any single plasticizer, Monsanto develops plasticizing systems tailor-made to fit your needs.

SANTICIZER: Reg. U. S. Pat. Off.

MONSANTO

WHERE CREATIVE CHEMISTRY WORKS WONDERS FOR YOU

NEW RELIANCE V★S Jr.

Get fast speed changes over a 30 to 1 range with this all-electric variable speed drive.

The new V★S Jr. gives you instantaneous speed changes, even under load, without belts, pulleys, or gears. This Reliance Drive puts the complete machine operation at the operator's fingertips. All functions, jog, start, stop, reverse and speed changes, are placed in a compact, remote control station.

There's a big power cushion in the motor, too . . . power for smooth speed pick up, even under heavy shock loads, and dynamic braking for fast controlled stops without shuddering or jerking.

The Reliance V★S Jr. is your answer to machinery drive problems in the ¾ to 4 horsepower range. Package construction makes installation easy; just plug it in to a single phase 220 or 440 volt a-c. line.

Write for complete details and prices. (D-1830)

RELIANCE ELECTRIC
AND ENGINEERING COMPANY

DEPT. 153A, CLEVELAND 17, OHIO • CANADIAN DIVISION: WELLAND, ONTARIO
Sales Offices and Distributors in Principal Cities

HARSHAW STABILIZERS STANDARD

for the Vinyl Plastic and Coating Industries

In these five Standard Units are all the necessary components to control effectively the degradation mechanisms that take place in polyvinyl chloride resins on aging, during heat processing or on exposure to sunlight. They are widely used alone and in combinations for specific effects in clear and opaque stocks. Their advantages have been proven over other tested materials, such as those based on tin (which frequently decolorizes effects of degradation without correcting them) or on lead (which frequently contributes to oxidation and breakdown on aging). We also supply combinations of components selected from these five Standard Units, to correct special conditions encountered in each Vinyl Processing Industry.

Write for information about stabilizers designed for versatile and inexpensive use in formulations employed in your particular vinyl processing industry.

Is it for—

Quality Vinyl Flooring?
Non-Plating Calendered Stocks?
Maximum Clear Sheets?
Non-Sulfur Staining Films?
Low Cost Clear & Opaque Hose?
Top Physical Properties in Rigids?
Air-Releasing Plastisols?
Controlled Slush Molding?

This Stabilizer System is for

CLEAR SHEETS
Cd 2-V-4
Org 8-V-1

The HARSHAW CHEMICAL Co.

1945 E. 97th STREET • CLEVELAND 6, OHIO

Inside view of insulation cap made of R/M Molding Compound LS-9184.

Side view of the same rocket insulation cap.

Missile fin made with Pyrotex Mat, after being subject to Mach 7 during a flight of 8 seconds. Strength and smoothness are maintained.

WANTED: A plastic material to withstand direct contact with burning rocket-propellants

PROBLEM:
High-temperature propellants present a major problem to rocket engineers. Possible failure of insulating materials in contact with them constitutes a major hazard to personnel. And it could destroy the rocket.

SOLUTION:
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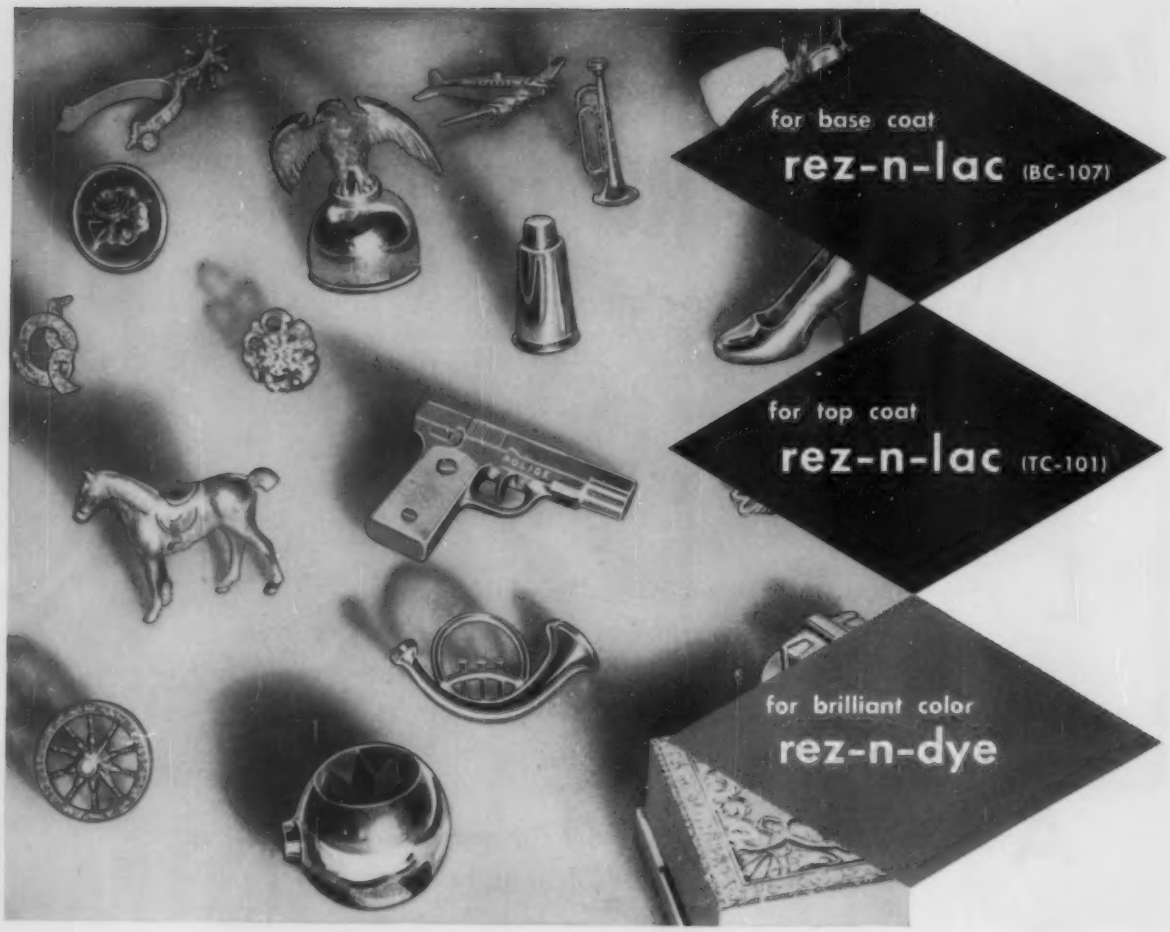

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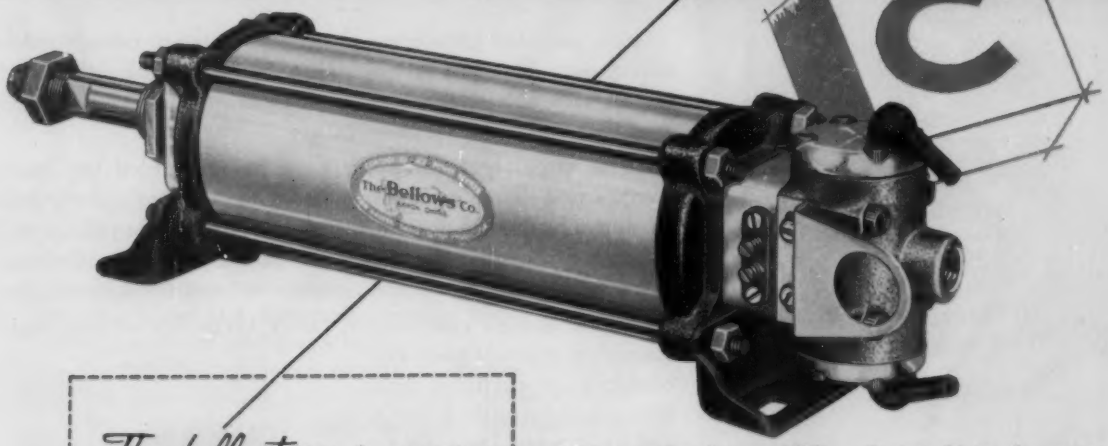

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News about

B.F.Goodrich Chemical *raw materials*

PLUG VALVE *of Geon for handling corrosive fluids demonstrates molding of complicated shapes with integral threads. At the bearing surfaces Geon is molded to another plastic.*

LOOK WHAT THEY'RE MOLDING IN GEON RIGID VINYL...

All parts shown made by Tube Turns Plastics, Inc.

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BIG FELLOWS *include piping tee and motor housing, requiring heavy cross section, chemical inertness, dimensional stability. By contrast, molding for automobile dashboard has thin section, large projected area.*

ELECTRICAL PARTS *include fractional horsepower motor housing which reduces appliance weight, and hanger band for transformer with Geon molded around metal bolt. Geon has excellent dielectric properties.*

AUTO HORN *trumpet shows complicated contours possible in rigid Geon. Note very thin walls obtained in this high-impact material. Photos courtesy Tube Turns Plastics, Inc., Louisville, Ky.*

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MODERN PLASTICS
Volume 34
March 1957
Number 7

Plastics on the West Coast

Almost everywhere in the world the growth of the plastics industries has been largely dependent upon the growth of end-user industries and the types of end-user industries established. And this is true of the Pacific Coast and Mountain areas of the U. S., but with significant additional factors.

First, is the population growth of the area. Table I, p. 124, points up this factor. While the total population of the U. S. increased 10.9% between 1950 and 1956, eight western states (Arizona, California, Colorado, Idaho, Nevada, Oregon, Utah, and Washington) increased 24% in population. Projections up to 1965 indicate that the national population will be 190 million at that time, representing a 13.2% increase from 1956, while these eight western states are expected in 1965 to have a population of 28½ million, representing an increase of 15% over 1956.

Second factor is the industrialization of the West which is proceeding along rather specialized lines. Until World War II the western economy revolved around agriculture, mining, oil, and the wood products industries. That war resulted in the establishment of the giant aircraft industries on the West Coast and the aircraft industries, now including missiles, led to the establishment of the electronics industries, the building of tributary metals industries, the expansion of the chemicals industries, and the creation of some plastics processing industries. The plywood industry, of course, was long established and a big user of plastics bonding resins.

A third exceptional factor in the growth of plastics in the Far West is the fact that the big new industries there provide incomes which are higher than average for the nation. This, coupled with clement climate, makes for a way of life and a standard of living that results in a unique marketing pattern. The urban West,

Table I: Population growth in the West

	[redacted]	[redacted]	[redacted]	[redacted]
UNITED STATES	150,000,000	167,191,000	10.9	190,000,000
ARIZONA	749,000	1,057,000	41.0	1,429,000
CALIFORNIA	10,586,000	13,433,000	26.9	18,000,000
COLORADO	1,325,000	1,612,000	21.7	1,760,000
IDAHO	588,000	625,000	6.1	693,000
NEVADA	160,000	247,000	54.6	307,000
OREGON	1,521,000	1,718,000	12.9	2,187,000
UTAH	689,000	812,000	17.9	961,000
WASHINGTON	2,379,000	2,667,000	12.1	3,244,000
TOTALS 8 STATES	17,997,000	22,171,000	Av. 24.0	28,581,000

with around 15% of the nation's urban population, is responsible today for a little more than one quarter of urban spending, yet buys one-third of the automobiles, over one-third of the cameras and photographic equipment, and more than 40% of the sporting goods purchased by city dwellers.* The population growth, coupled with the income factor, has brought about the country's highest rate of home construction.

A fourth factor, perhaps intangible but nevertheless effective, is the attitude of the people of the Pacific Coast and Mountain states toward life and living. This shows up in the above-mentioned marketing pattern; it shows up in the relatively low sales of personal insurance policies; it shows up in the pioneering attitude of technologists, engineers, and marketing men—an attitude which has given to the plastics industries such processing improvements as huge sandwich structures, pinpoint gating, automated encapsulation, biaxial stretch forming, and high-heat-resistant laminates.

The fifth factor is one of fairly recent origin and was brought about because, while the West does not have large manufacturing complexes, the growing needs for plastics in the area have led to plant acquisitions, expansions, and the construction of basic plastics raw material plants. Certainly present trends in this respect indicate that this area will not only become more and more self-sufficient in the matter of resins and molding materials, but it will soon have sufficient production of several materials to enable it to distribute nationally.

Against the background of the foregoing five factors for growth, it may prove to be advantageous to study a number of fields of plastics activity.

Plywood and particle board

The plywood industry has long been the largest consumer of plastics resins in the West and is growing as fast as, or faster than, any other western industry. In 1950, 2 billion sq. ft. of plywood were produced in the Pacific Northwest; in 1957 volume projection is for 4 billion sq. feet. This year 75% of the nation's total plywood supply will be produced in that area, and will account for the use of over 120 million lb. of phenolic, urea, and resorcinol adhesives.

The wood waste board or particle board industry is growing rapidly, although no statistics are available.

Aircraft and missiles

The Pacific Coast and Mountain states account for one-half the nation's aircraft production and this industry is a major consumer of many plastics. As mentioned above, the aircraft and missiles industry has been a major user of and process development source for reinforced plastics. Out of this research and development is coming a new approach to composite structures which is already having an effect on building construction. This industry may also be thanked for the rapid extension of the use

*From "Harvard Business Review," Vol. 35, No. 1, Jan. 1957.

of plastics in the electronics field—in printed circuits, potting, and miniaturization.

Each month sees new advances in resin and composite structure technology tributary to the highly specialized needs of the missiles field. Of particular importance are heat-resistant plastics structures presently capable of withstanding temperatures up to 600° F., and stronger than titanium at that temperature. Momentarily word is expected of plastics composites capable of withstanding temperatures in excess of 1000° F. for such periods as might be required.

Agriculture and pipe

Because much of the arable land in the Far Southwest has been made so by irrigation, (over 25 million acres of land are involved) the use of plastics pipe for water transmission has been vastly encouraged in the area. Case histories of success in this application are numerous and are bringing about not only the further use of plastics pipe to replace pipe made from non-plastics materials, but are also bringing about the extension of irrigation to new territory.

In Southern California was developed the first use of plastics pipe for gas transmission from mains to homes, butyrate pipe being largely used inside existing metal transmission lines. This program has been most successful and is being extended. The use of polyethylene pipe for jet wells received great impetus in the western states and is now a business on a national basis. High-density polyethylene pipe is expected to increase this market where heavy water pressure may be encountered. Both unplasticized polyvinyl chloride and styrene copolymer pipe are continuing to show good progress.

The use of film in conjunction with growing and protecting crops offers one of the largest over-all growth potentials in the West for any plastics material. To date 75% of the polyethylene film used in agriculture applications has been in the West and Southwest, but, except for the strawberry crop, such use has been largely developmental, in mulch covers, fumigation covers, silage containers, crop protectors, and greenhouse covers.

The extended use of polyethylene and polyvinyl chloride films and others is expected in the next few years to revolutionize farming practice in the big fruit and vegetable growing areas in the West where it is known that the size and quality of crops produced can thus be improved and that the number of crops grown on a given acreage per year can be increased.

Building construction

The high rate of residential and industrial construction recorded over the past few years in the Far West has been responsible for the building of big industries to produce corrugated and flat reinforced plastics sheets. Likewise, the outdoor-indoor living pattern of the people has brought about a big business in vinyl chloride garden hose and in polyethylene pipe for sprinkler systems.

Over 1 million lb. of polyethylene film were used in the eight western states with which we are concerned in construction applications in 1956. Material makers expect this market is to triple by 1960.

Packaging and containers

With the important exception of produce packaging, the growth of the use of plastics in packaging on the West Coast has not been as rapid as in some other areas of the country. But both polyethylene and cellulose acetate are being widely used in packaging fruits and vegetables, and this is a fast growing field. Acetate is used where a "breathing" wrap is wanted. Polyethylene, now used in bags for packaging certain fruits and vegetables, is finding an important application in air-tight cardboard containers, packed with both produce and carbon dioxide to permit fruit to ripen in transit.

Out of an estimated 40,000 boats expected to be made this year, approx- (*To page* 258)

Table II: Western[a] plastics processing

Material	Western Sales 1957 (Est.) Millions of Pounds	Percentage Processed In The West 1957 (Est.)
Polyethylene resin	60-70	85-90
Styrene resin	30-35	70-80
Polyvinyl chloride and copolymer resins	60-65	40-50
Polyester resin	8-10	90-95
Phenolic and urea resins and adhesives for plywood	140	100

[a]Washington, Oregon, California, Idaho, Nevada, Arizona, Utah, and Colorado.

Mass-produced

One of the most exciting groups of plastics to come to industry attention in recent years are the polyurethanes. And the prime predicted application of these resins has been in the form of foams, both rigid and flexible. Basic problems in the development of low-cost mass production of foams from polyurethane resins were 1) the need for standardization of chemicals used in foam manufacture and 2) the need for proved high-speed mechanical handling of the foamable liquids.

A development of a pioneer polyurethane producer, American Latex Products Corp., Hawthorne, Calif., a wholly owned subsidiary of Dayton Rubber Co., is a fully automatic materials production unit with a present capacity of 25 million lb./yr. and a resilient foam production line with a stated capacity of about 15 million lb./yr.

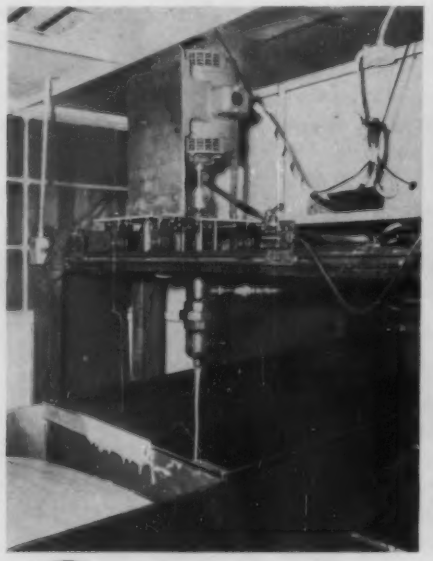
Originally Alpco, a leading producer of foam rubber, was licensed by Lockheed Aircraft Corp. for the production of rigid forms of polyurethane for such airframe uses as radome construction, reinforced plastics, and aluminum sandwich construction for rocket launching doors, target drone wings, void spacers, and aircraft ailerons.

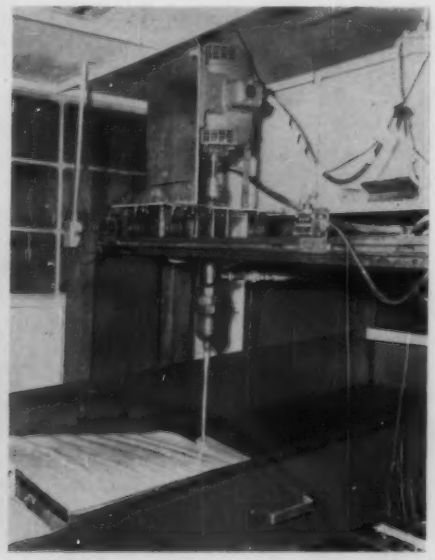
Following much work on the rigid foams which are used for refrigerator car insulation and for various nuclear devices as well as for aircraft and missile work, the company received licenses from two other producers of basic polyurethane chemicals, Du Pont and Mobay, and proceeded with the development of flexible foams for cushioning. Work to date is stated to indicate foreseeable markets for all types of polyurethane foam of well over 75 million lb. by 1960.

Failure at first

Early problems generated by the variable nature of basic chemicals were tremendous, with each batch requiring exhaustive laboratory testing. Early "blows" were variable in composition, density, and "memory," or set. Early attempts at mass production resulted in

Foam slab poured in two minutes





Mixing chamber for production of polyurethane foam at the beginning of a blow. Time required to . . .

. . . fill pan completely is 120 sec.; motor is connected directly to mixing head rods, and the . . .

polyurethane foams

How chemical and mechanical engineering research have brought these new materials to production line use

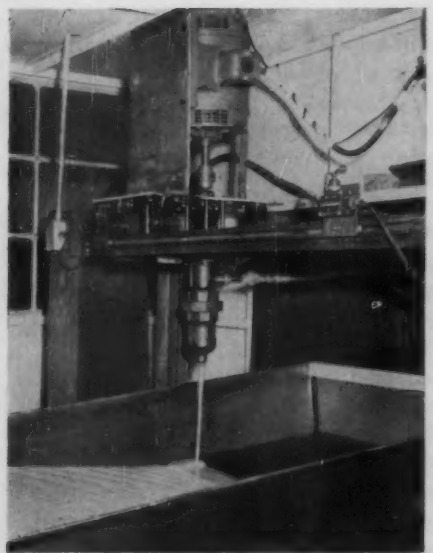
failure, the principal cause being that the rapid foaming action prevented thorough mixing before the foaming action started. Many other problems confronted Alpco production men.

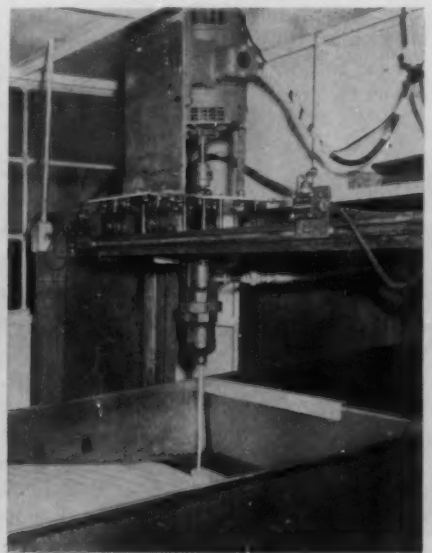
Although Alpco was licensed by all three producers of basic chemicals, very little technical information was available concerning mechanical and automatic equipment and processes. Thus it became the burden of Alpco engineers to develop such equipment and, indeed, an entire production system for processing polyurethane foams. By the spring of 1955 chemical formulation and production techniques were perfected to the point where uninterrupted mass production was possible.

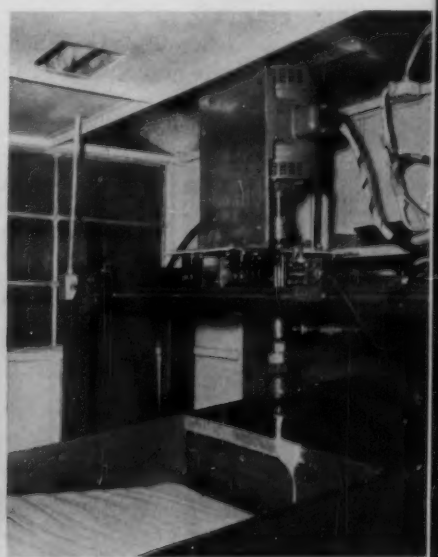
The current, much more refined production line consists principally of a moving, powered mixing head fed by a system of pressure vats and pumps, a simple conveyor system, and an electrical oven, all controlled electronically. The machine is operated intermittently according to customer demand and produces approximately 7 million lb./yr., approximately half of its potential capacity.

Basic chemicals are purchased in carload lots, processed under rigidly controlled pressure and temperature preparatory to mixing, which is accomplished by either of two basic systems, the *aduct* or the *prepolymer* system. Key to the success of the production line is the design and flexibility of the mixing head.

Experiments proved that no single mixing







. . . **head** rides on dolly guided by traverse screw. Microswitches limit and reverse travel . . .

. . . **Beneath** rails is interchangeable mixing nozzle and orifice. Photos were taken at 30-sec. intervals. . . .

. . . **As** soon as one pan is full, next blow is started. (Photos, American Latex Products Corp.)

Mattress-size blow is removed from polyurethane production line after passing through oven in foreground and curing chamber in center. Mixing chamber is at far end

Finished slab is weighed and graded while worker in foreground applies parting agent to pan for next blow

head would fulfill all of the requirements for mixing the infinite variety of polyurethane variations now possible. The solution lay in the design of a basic mixing head to which can be affixed several different mixing chambers and nozzles; each can be fitted with any one of several different mixing rods. This selection permits a range of density from almost microscopic cell structure to as much as ½ in. in size. The heads themselves can control cell structure up to approximately 1/16 inch. Larger sizes are produced by the addition of increasing amounts of chemicals to the mixture at the head.

Generally, production is confined to three density grades, arbitrarily named soft, medium, and firm. Densities of these range from 2 to 3½ lb./cu. ft. A typical example: soft grades in a 10-in. blow are produced with a head mixing speed at about 2500 r.p.m., which produces a flow of 35 lb./min.

Mixing is provided by a multi-horsepower motor mounted directly on top of the head. In the early designs it was discovered that a motor coupled to the head with chains permitted a variation of between 100 to 300 r.p.m. This created an unsatisfactory variation in density, even within one mattress-size slab. The company's production men solved the problem by using a direct drive from the motor straight through to the mixing rods. Such an arrangement now holds speed variation to less than ±2 r.p.m.

Of course, selection of proper nozzle design is quite important in controlling the volume of flow.

By using pans without end pieces and folding hem-type pan sides, endless pieces of foam can be produced. Automatic equipment cuts slab to 50-ft. lengths, saws it into various thicknesses, rolls them up, and stacks the rolls. (Photos, American Latex Products)

Pans on conveyor belt

Beneath the head is a conveyor belt supporting steel pans treated with a parting agent (a specialized product) and moving at a rate of 4 to 10 ft./min. The mixing head is placed over the pans and coupled to a traverse screw through an adjustable speed reversing motor that moves the unit laterally over the moving pans. Microswitches at either end of the screw actuate the reversing motor and are adjustable for width of head travel. A critical factor was found to be the rate of introduction of the polymers and isocyanates to the mixing head. Exact control is mandatory. About 15 p.s.i. pressure was found to be ideal in the storage tanks, and the ratio of flow of the separate compounds must be extremely ac- (*To page* 264)

Base housing and arm assembly of aircraft seat, as well as built-in food tray (shown in retracted position) are formed of vinyl-styrene alloy sheet

Side view of reclining seat assembly, with formed service tray lowered into use position. (Photos, Burns Aero Seat Co.)

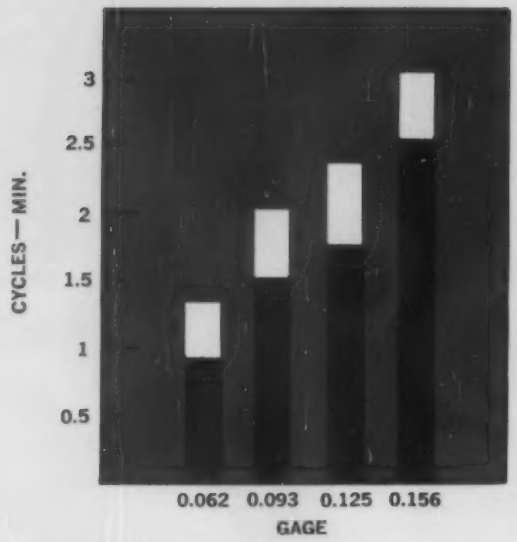
Thermoformable, flame-resistant

New vinyl-styrene alloy sheet has unique physical properties

In production this month on a limited basis and already giving promise of service to many interesting fields of application is a new fire-resistant thermoformable thermoplastic sheet tradenamed "Fireban."

A joint development of two affiliate Southern California companies—Charles Crowl Co., El Monte, and Ellay Rubber Co., Los Angeles—the new material, the exact composition of which is a carefully guarded secret, is declared to be a unique alloy of vinyl and styrene resins. It is flame resistant without benefit of added fillers and other flame suppressants, so enjoys the advantage of low specific gravity.

The new sheet is intrinsically endowed with excellent physical properties, as is indicated in Table I. Its makers claim it to be lighter in weight, to have higher tensile strength, higher modulus of stiffness, higher thermal distortion temperature, greater percentage elongation, and higher Izod impact strength than other flame-resistant thermoformable sheets now be-



Minimum (black) and maximum cycles for forming various gages of new sheet. (Graph, Crowl)

ing offered. A product of the calender, it combines the economy of styrene-based materials with the brilliant colorability and color stability normally associated with vinyl.

The Fireban sheet may be readily formed by all conventional methods—slip, vacuum, snap-back, blow, and plug-and-ring. Such operations as cutting, shearing, punching, routing, welding and riveting can be performed on it. It can also be polished and cemented.

Many forming advantages

The outstanding physical characteristics of this product are declared to result in many forming advantages. One phenomenon of the material is that although it has a high heat distortion point, it forms, free from chill marks, at relatively low temperatures, with excellent grain retention. Lower heat requirements, plus a shorter heat cycle, result in an important fabrication cost factor.

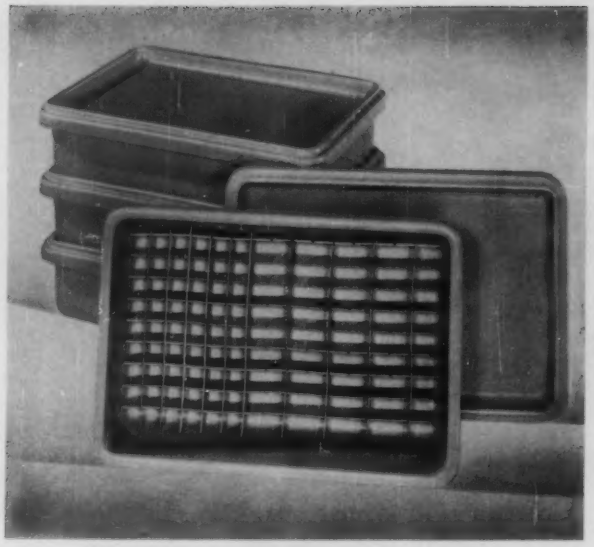
Fast heat dissipation in the sheet is another unusual characteristic. It chills quickly on the mold, and in many cases allows the elimination of water-cooled molds.

Deeper draws with excellent definition are made possible by the sheet's increased elongation. Its high tensile strength is claimed to produce stronger parts, even when drawn excessively. Therefore, gages lighter than normally used for a specific job can result in stronger finished parts.

This product is the result of 18 months of technical development work following an intensive market survey which determined that there was an increasing need for a stronger, lighter-weight, flame-resistant, and thermo-

Typewriter silencer is fabricated of parts formed of impact-resistant vinyl-styrene sheet. (Photo, Blackman Plastics, Inc.)

Tough, weather-resistant, and decorative housing for electronic instrument is formed of new material. (Photo, Jewett Mfg. Co.)



Deep-drawn missile component trays of Fireban have high impact strength, are flame resistant. (Photo, General Plastics Corp.)

formable plastic sheet. The cooperating companies have worked mightily not only on the difficult problem of calendering such an alloy, but on surface finishing, stress-relieving, and forming methods. Charles Crowl Co. has installed several types of conventional forming equipment for the establishment of valid data on the fabrication of the sheet, and is prepared to assist fabricators and end users in design and forming problems.

Ready markets available

Market-wise the sheet is expected to find a ready niche in the field of transportation. It is suitable for refrigerator truck-trailer liners, for use in trains and aircraft where lighter weight, strength, and vibration-resistance are required. To it may be applied overlayed surfaces such as gold foils, fine fabrics, and other devices for special effects; it is also available with a number of decorative embossed textured surfaces.

Military applications are photo-restricted but include its use in the development of the U. S. Air Force high-velocity, collapsible survival rifle and in contour packaging for airborne droppable electronic equipment and ordnance equipment.

The luggage field is, of course, a natural. Housings for air conditioners and business machines is another. The high tensile strength and impact resistance of the sheet, plus its resistance to alkalies, acids, solvents, grease, and oils, it is expected, will lead it into the materials handling field in tote pans, trays, and containers.

Of special interest to thermoplastic sheet formers, whether custom, proprietary, or captive, is Crowl's new modular merchandising method. Historically a basic economic problem of such fabricators has been losses on trim because of sheet sizes available. The modular method is to sell standard dimensional sizes in multiples of six inches. This helps reduce costs on trim scrap, minimizes freight charges, cuts material handling costs, saves warehouse space, and can increase production. The handling and storage of large sheets is replaced by easy-to-handle, light-weight packages. This method also eliminates heavy shearing facilities and, consequently, the hazard of mis-shearing large sheets.

Through a by-the-pound price system, combined with easy square-foot conversion tables on present modular dimensional sizes of the product, job estimating is made easy for the fabricator.

The new sheet is available in a rainbow of colors and in all standard gages from $\frac{1}{32}$ to $\frac{1}{4}$ inch. Special gages can be tailored on volume orders.

Table I: Typical physical properties of Fireban F-200

Specific gravity	1.2
Tensile strength, p.s.i. (A.S.T.M. D638-46 T)	4700
Elongation, % (A.S.T.M. D638-46 T)	97
Hardness	
Shore—D	87
Rockwell—R	90
Impact strength, notched Izod, ft.-lb./in. (A.S.T.M. D256-47 T)	
at 77° F.	10.7
at 20° F.	2.1
Heat distortion (A.S.T.M. D648-45 T)	
at 66 p.s.i., °F.	192
at 264 p.s.i., °F.	175
Maximum shrinkage, 325° F., %	6
Modulus of stiffness in flexure (Olsen)	
75° F., p.s.i.	420,000

Great variety of shapes and sizes of pressure-resistant products is indicative of the versatility of the filament winding technique. (Photo, Aerojet-General Corp.)

Filament winding has a fine future

Reinforced plastics structures produced by this relatively new and versatile method can have predetermined design strength in almost any conceivable shape

By George Epstein and Harry A. King**

Probably the strongest hollow structures made to date have been products created by filament winding.

This is a process in which continuous glass roving, impregnated with a suitable resin, is wound upon a form which corresponds in shape to the interior configuration of the fabricated part. The form is disposed of after the resin has been cured by heat. The technique offers some advantages over conventional methods of fabricating glass-reinforced structures.

First, the roving is inexpensive and readily available. Second, the windings conform to complex curvatures. Third, glass reinforcement may be laid on the winding form so as to provide the optimum position and angle from a strength standpoint—thus, directional properties may be obtained efficiently. Fourth, wind-

*Research and Development Group, Structural Plastic Dept., Aerojet-General Corp., Azusa, Calif.

Table I: Properties of filaments

Material	*Type*	*Density*	*Yield strength*	*Weld strength*[a]	*Specific yield strength*[b]
		lb./cu. in.	p.s.i.	%	in.
Stainless steel	17-7PH	0.276	160,000	90	522,000
Stainless steel	410	0.276	150,000	90	490,000
Steel	4130	0.282	150,000	90	480,000
Aluminum	6061-T6	0.098	35,000	100	357,000
Aluminum	7075-T6	0.101	66,000	100[c]	653,000
Epoxy-fibrous glass	Aerojet	0.068	50,000	No welds	735,000
Titanium		0.171	120,000	100	702,000

[a]Percent of yield strength.
[b]Specific yield strength equals yield strength times weld strength divided by density times 100, which is essentially the strength/weight ratio of welded structures.
[c]New techniques for welding 7075-T6, thought unweldable, give 100% weld strength.

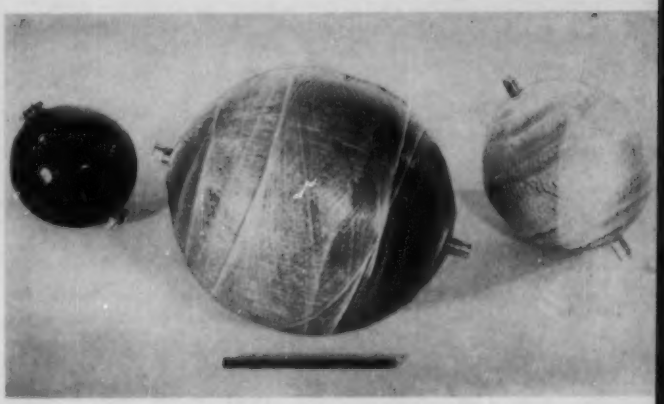
ing is performed with the glass filaments under a uniform and controlled tension so that all filaments will be evenly stressed when the structure is finally subjected to loadings, and close dimensional tolerances may be maintained. Fifth, as may be seen from Table I, higher specific tensile strengths can be realized than with many other materials.

As the illustrations herewith show, Aerojet-General has developed techniques and processes for making filament-wound structures of spherical, elliptical, tubular, cylindrical, and other shapes. Almost any conceivable shape may be produced.

The finished structures possess high strength, light weight, and corrosion resistance. Some of the mechanical properties of glass filament-epoxy structures are listed in Table II. The specific tensile strengths of these materials are appreciably greater than those of aluminum and steel. Also, these materials are substantially unaffected by prolonged exposure to water, hydraulic fluids, and fuels. Pressurized vessels fabricated from these materials are known to be shatter resistant when penetrated by projectiles.

For pressure vessels a liner is generally required to confer the necessary impermeability to enclosed gases. Normally, a liner of cured butyl rubber is used for this purpose although, where unusual resistance to special materials is required, other liners such as Buna-N, neoprene, or plastics may be used.

From a design standpoint, the business of filament-wound structures, (*To page* 267)



Filament-wound reinforced plastics structures can be designed to precise weight-strength ratios in any direction

Table II: Mechanical properties of filament-wound structures at room temperature

Ultimate tensile strength, p.s.i.	
Non-directional	50,000
Unidirectional	120,000
Density, lb./cu. in.	0.068
Specific tensile strength, in.	
Non-directional	735,000
Unidirectional	1,765,000
Elastic modulus in tension, p.s.i.	
Non-directional	3×10^6
Unidirectional	5×10^6

15,526 man-hours

H-O gage train, accurately scaled from official railroad blueprints, derives much of its realism from the many plastics components that go into its makeup. (Photos, Revell, Inc.)

A program of product design and engineering, particularly where the product is as highly complicated as a many-component model railroad line, is an expensive thing to begin, a worrisome thing to engage in, and an awesome thing to behold.

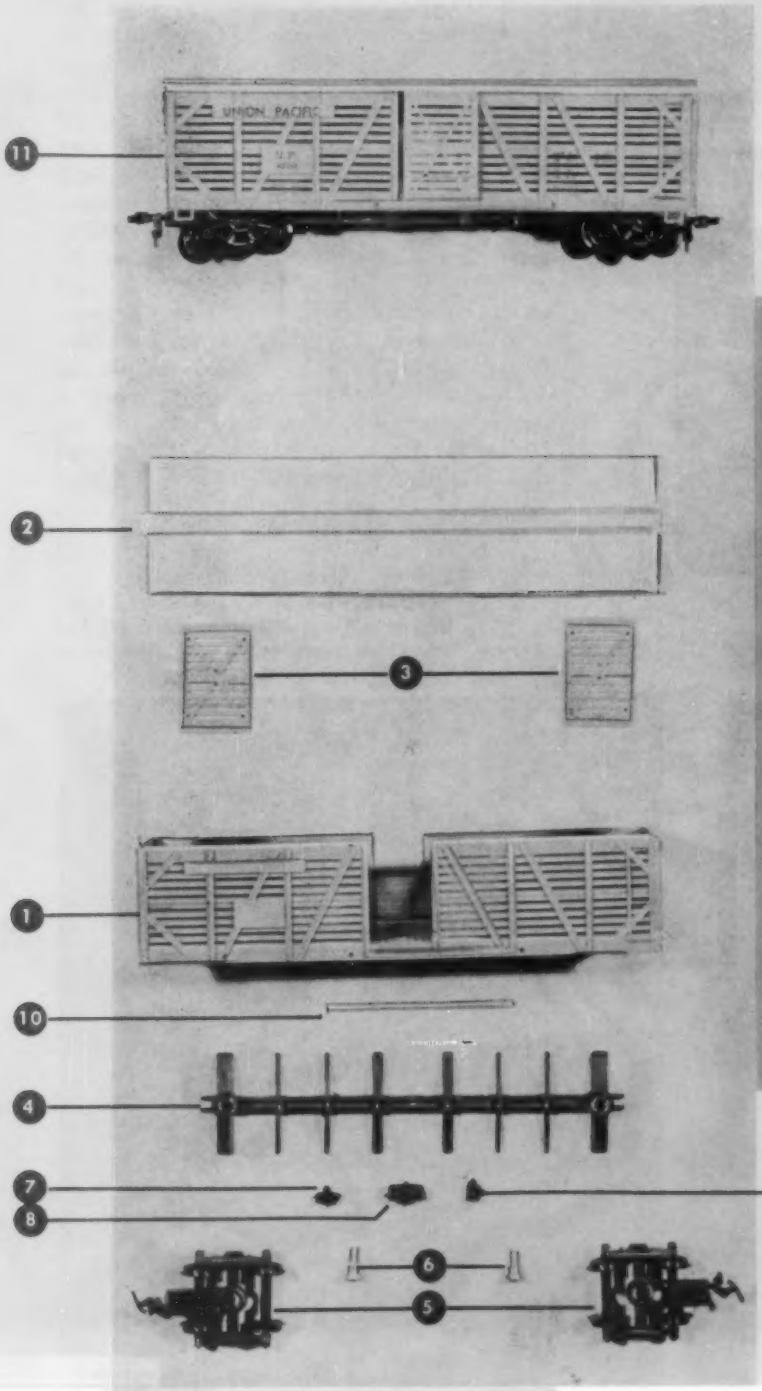
Normally the development of a ready-to-run line of H-O gage electric trains would be a matter of years, not months. But the market awaited the product and Revell, Inc., Venice, Calif., having a great background of experience in plastics model kit construction (see MODERN PLASTICS *32*, 89, Nov. 1954 and *32*, 94, Jan. 1955) felt impelled to tackle the enormously complicated problem of producing by Christmas 1956 a completely engineered line.

Market research had indicated that there were two reasons for the big consumer demand for H-O gage trains: first, because they are half the size of conventional O-gage trains, it is possible to truly scale the equipment; second, because a complete H-O railroad takes up only half the home space of former scale trains, which appeals to adults as well as children. The market research also showed that complete units were wanted rather than assembly kits, because while most of the satisfaction in scale model assembly is derived from the completion of the model, with electric trains most satisfaction comes with the operation. Furthermore, because of their complicated mechanical components, trains can best be assembled by skilled people.

In preparation for the tooling, 15,526 man hours were spent in design alone, with an approximate investment of $600,000 for tooling and plant layout to launch the initial line. Illustrations herewith show what a complicated proposition that was, with minute precision parts being the key to quality of the finished product.

Typical of Revell's growth was the result of

were spent in design alone to launch
a new line of model trains, which resulted in
plant decentralization and the establishment of new services



Revell H-O model of Union Pacific stock car

Part	Weight	Plastic	Metal
	g.		
1. Cattle car body	28.245	Hi-impact Styron 475	
2. Roof	13.545	H.I.S. 475	
3. Doors	1.470	H.I.S. 475	
4. Metal under-frame			Die cast
5. Freight car trucks			Die cast, wire-formed parts
Couplers (not numbered)	0.095	Zytel 101 nylon	
6. Truck pivot screws			Screw machined
7. Triple valve	0.053	H.I.S. 475	
8. Auxiliary reservoir	0.245	H.I.S. 475	
9. Brake cylinder	0.080	H.I.S. 475	
10. Door slide			Punch press
11. Completely assembled cattle car	Total weight of plastic parts, 43.733 g.; total weight of completely assembled model including metal parts, 80 grams.		

Bells, ladders, and other minute details are manually solvent-welded to styrene body shells

this development in terms of facilities and approach to marketing. First, it was found that the company's tooling facilities, in order to meet current demand for its basic hobby kit product as well as for the H-O trains, had to be increased by nearly 45% in order to assure continuity of production and to make possible quick creation of new items. Second, it was found that an Eastern plant would have to be obtained to provide better and faster service to the company's dealers and jobbers on the Atlantic seaboard. An existing facility of 50,000 square feet on 16 acres of land is now being tuned up at the South Plainfield, New Jersey plant. This plant, managed by Paul Escoe, will operate on a relatively autonomous basis with scheduled air shipments of molds between both East Coast and West Coast in order to achieve the highest efficiency at the minimum of tooling costs. Third, Revell discovered a demand for its services in designing, engineering, and molding precision parts for other companies, so an Industrial Div. has been set up under Robert Bloom to use the engineering, tooling and production facilities on a custom basis for the end-user industries. Integration of the Industrial Div.'s activities with the over-all Revell facilities is under the direction of Robert Hamel.

Rolling stock is sprayed in authentic colors with special paints. Mask is of electroformed metal

Cabooses are assembled on circular moving table. Speed of table rotation is adjusted to permit ample setting time after floor is solvent-cemented to car body

One of the complex molds used in producing parts for the trains. (Photos, Revell, Inc.)

Non-breakable cases for portable record players are compression molded of sisal-reinforced phenolic premix material containing a resin extender produced from Douglas Fir bark. (Photos, Admiral Corp.)

A case for quality at low cost

New natural resin extender, added to sisal-reinforced phenolic material, brings economy to molded record player cases

A product of Pacific Coast research at Weyerhaeuser Timber Co. is a new resin extender made from Douglas Fir bark by a patented fractionation method. The new material contains natural plasticizers, cellulose, and resins. Having a content of approximately 47% cellulose and 45% lignin, it flows under heat and pressure without additives, yet will not flow under heat alone. It is called Sivacon 412.

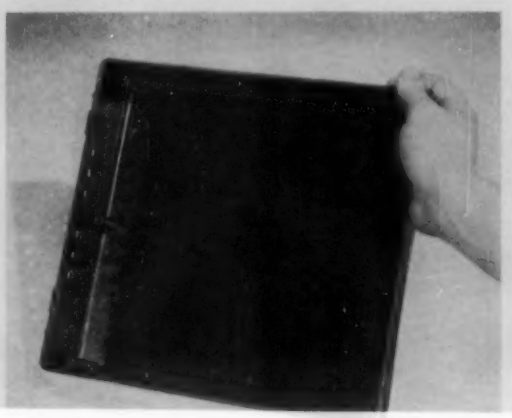
One of the first molding jobs to use this extender to secure lower material cost without sacrifice of quality is the non-breakable, luggage-styled cases of sisal-reinforced phenolic material chosen by Admiral Corp. for two new single-play portable record players.

Equipped with convenient carrying handles, the new phonographs are made in two basic sizes. Over-all case dimensions of the three-speed model are $4\frac{5}{16}$ in. high, $9\frac{1}{2}$ in. wide, and 12 in. deep; the four-speed model, which also accommodates the new $16\frac{2}{3}$-r.p.m. "Talking Book" records, uses a case measuring $4\frac{7}{16}$ in. high, $11\frac{7}{16}$ in. wide, and $12\frac{3}{16}$ in. deep. Both styles of cases are light in weight, resist scratches, stains, and scuffing, and are easily cleaned with a damp cloth.

Both cases are molded with mating top and bottom sections which are joined at the back by metal hinges. A luggage-type catch holds the cases securely closed for carrying. Both models are offered in a molded black integral color; in addition, they are available in tan top and bottom and a combination of luggage white and tan. The colored units, molded in a natural phenolic color, are painted to achieve the final finish.

In both styles of record players, the "motor board" which mounts in the lower section of the case and covers the electrical and mechanical parts of the unit are injection molded of high heat resistant, high impact (*To page* 266)

Close-up of base for smaller case. Part weighs 1½ pounds. Cored openings are for ventilation and attachment of hardware



The

Variety of polyester-glass hats: upper right—power-line worker's cap with special specifications for electrical resistance; upper left—hat for construction worker; center right—miner's caps; center left—construction man's headgear for night work; lower right—fireman's helmet. (Photos, E. D. Bullard Co.)

hardest-boiled hats

How a company, specializing in safety helmets, collaborated with a reinforced plastics molder to build a world-wide market for a high-standard line

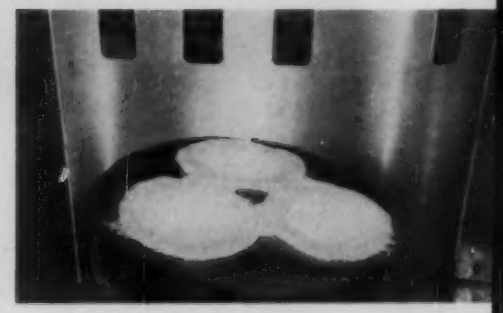
Almost 1½ million reinforced plastics safety helmets, averaging 14 oz. in weight, represent a total material use of about 1⅓ million pounds. That is what has been molded in six years for E. D. Bullard Co., Sausalito, Calif., by Automatic Plastic Molding Co., Berkeley, Calif., and that is probably the longest-run reinforced plastics molding job in history.

The story begins in 1919 when E. W. Bullard started making industrial safety helmets out of kraft paper laminates, then switched to vulcanized fibre, then to a sisal-phenolic material, and finally to polyester with fibrous glass. It involves constantly improved design and testing, the establishment of specialized standards for hats for different fields of use, sincere and responsible merchandising, and promotion. And the story goes on into the future with Bullard's recent announcement of a molded tough thermoplastic hat produced from a material called Estherene, the nature of which is secret at present.

Bullard makes safety hats and caps for the construction field, for power line workers, for miners, and for firemen. Each of these fields has different requirements in terms of protection. So the company has concentrated on standards and specifications for the different fields in which head protection is required. Thus has come about the Edison Electric Insti-

Before fibrous glass-reinforced plastics safety helmets are molded, preforms are placed into oven, three at a time, for precure

Three helmet preforms in plenum chamber of preform machine. Precision preforming assures uniform distribution of reinforcement



Operator removes finished helmet from mold at end of cycle with aid of compressed air. These "hard-boiled" hats are molded in single-cavity tool-steel molds

tute specification for electrical workers' insulating safety headgear, which must be water resistant, impact resistant, an electrical insulator, and flame resistant, and the General Service Administration specification for construction workers' helmets which must have extremely high resistance to impact.

Aside from the four fields mentioned above, the "Hard-Boiled" hats (a Bullard name) are sold to shipyards, police forces, steel mills, chemical plants, oil field crews, timber companies, and civil defense units. Where new hazards develop, new specifications and standards will be built to meet them, but for present markets the specifications so far established seem adequate.

As a public relations feature, E. W. Bullard is international sponsor of the "Turtle Club" to which automatically belongs any person whose life has been saved by wearing any safety hat made by anyone anywhere. To date over 2000 people all over the world are members who are pledged to encourage others to "practice safety first, and last longer." The man who founded the idea of the club is C. R. Rustmeyer, Safety Director of Canadian Forest Products Ltd., Vancouver, Canada.

The reinforced plastics hats, as molded by Automatic, represent most precise preforming for uniformity of reinforcement and exact metal-to-metal molding to obtain high density and freedom from voids.

Any hat or cap in the line may be had with or without a lamp and may be had in any of 29 colors, including phosphorescent.

Molten metal (3000° F.), which "walks" through other helmet materials, sprays harmlessly off reinforced plastics hat

Helmet below, tested according to Fed. Spec. GGG-H-142b, withstands 40 ft.-lb. impact (8-lb. ball traveling 5 feet)

Awesome idol, over 7 ft. tall and with intricate undercuts, cast of polyester resin and metallized, makes effective movie prop. (Photo, Society of Motion Picture and Television Engineers)

Plastics steal the picture

How the movie studios are making use of many plastics to speed production, cut costs

The constantly expanding role which plastics are playing in the motion picture industry offers a virtually untapped mine of opportunity for other commercial applications. Every day these materials are being used to solve an amazing variety of problems, both structural and decorative, that are little known outside the studios, yet have their counterparts in scores of other industries.

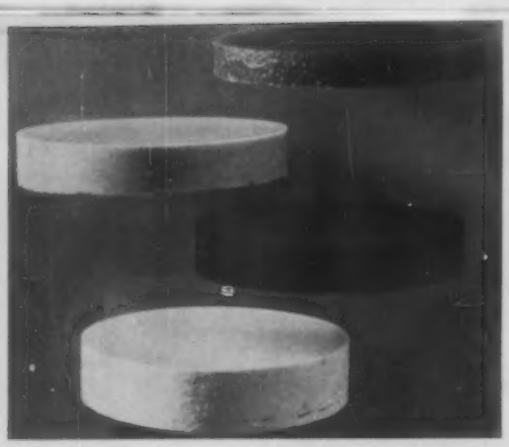
Throughout the studio from wardrobe department to nursery and prop shop the uses of plastics have multiplied at a phenomenal rate. More are yet to come. Some of the most noteworthy are highlighted as follows by Dr. Herbert Meyer, Chief Chemist of Hollywood's Motion Picture Research Council, testing spearhead of the motion picture industry.

Thin film biggest news

Headlining recent film developments is Du Pont's Cronar (1)[1], thinnest, toughest, photographic film base yet developed. Made of polymethylene terephthalate, it is only 4 mils thick as compared with 5.5 mils for standard film.

Extensive tests by motion picture studios

[1]Numbers in parentheses refer to list of credits on p. 268.



Hollywood goes for polyesters, filled with, top to bottom, asbestos, inorganic Microballoons, phenolic Microballoons, urea Microballoons. Fillers are 10% by weight. (Photo, Motion Picture Research Council)

Quick-peel methyl cellulose-based paste permits peeling of wallpaper without harming wall or paper. (Photo, SMPTE)

Stellar attraction is styrene "glassware," which solves breakaway problems. Clarity is shown by sheet in center. (Photo, MPRC)

under the sponsorship of the Motion Picture Research Council show that film made from this condensation polymer is outstandingly superior in folding endurance, tear strength, and projection life.

It is four times more stable than standard emulsion base; tear strength averages 180 as compared to the present 65; film can be folded more than 15,000 times before breaking, as against triacetate's endurance of 40; it is optically clear and insensitive to humidity. Prolonged storage, even at 100° C. will not affect its stability.

Of special significance to the television field is an even thinner Cronar base of 2½ mils being considered for 16-mm. film. It is reported that Du Pont is scheduling full-scale shipments of Cronar in the near future, and will convert all its photographic film products to the polyester base as production capacity permits.

"Polys" take the lead

Despite their comparatively high cost, both polyvinyl chloride (2) for molds and polyester resins (3) for casting continue to supplant plaster in many studio uses. PVC molds are flexible, long lasting, and require no release agent. The casting resins, both plain and reinforced, can be cast to a small fraction of the thickness and weight of plaster, yet the finished product will withstand considerable abuse without chipping or breaking.

Fillers cut polyester costs

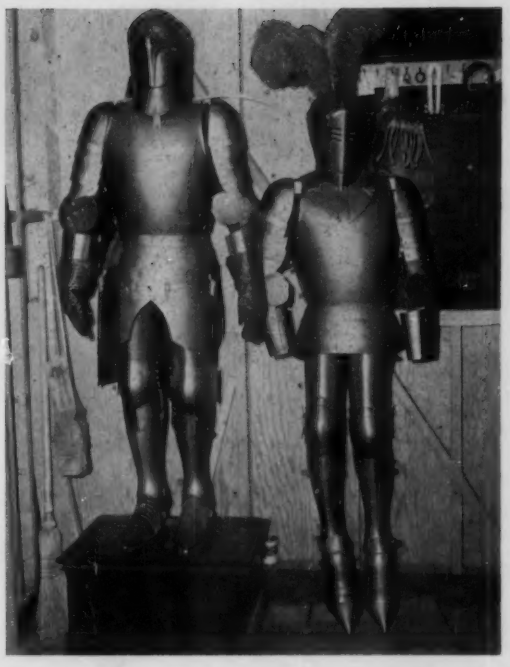
Experiments with the recently developed plastic Microballoons give every indication that they will ease some of the problem of low-cost fillers in polyester resins for lightweight set construction. These tiny gas-filled plastic spheres are presently available in brown phenolic (4) and white urea formaldehyde (4A).

These materials give low density and good strength. They are real cost-savers because of the increase they provide in volume rather than weight in the resin-filler mix.

Smash hits

Lightweight rigid foamed phenolic resins (5) are becoming contenders with the plaster-and-sawdust slurry now generally used for casting "breakaway" rocks, walls, beams, and

Colossal breakaway beams of foamed phenolic weigh under 10 lb., can be ground, sanded, sawed, painted, and drilled. (Photo, SMPTE)



Bold knights of yore are garbed in realistic armor made of thermoformed and metallized sheet. (Photo, Universal-International)

other collapsible structural sections. When mixed with chemical additives these set quickly to an end product that can be modified within a wide range by the amount of foaming powder used.

Breakaways such as transparent glassware, bottles, window panes, etc., now depend on synthetic hot-melt compounds for more efficiency. They include Monsanto's Santolite (6) which reaches pourable viscosity and maintains fluidity at relatively low temperatures, and Dow's polystyrene (7) which shows no tendency toward cold flow in storage or when exposed to the higher temperatures of lighted sets.

Pistol-whipping and stabbing scenes are effective but harmless when using polyurethane foam weapons. (Photo, 20th Century Fox)

Finishing—fancy and fast

A spectacular spray process (8) now eliminates costly plating of set decorations and creates striking metallic or mirrored effects on wood, metal, or plastic. Plaster or other porous materials can also be sprayed successfully provided that a good sealer is used.

The simple three-step operation requires only a twin-nozzle spray gun in addition to standard spraying equipment, all commercially available. First the surface is completely sealed, then a mirror-like silver layer is sprayed over it. Third, a coat of clear or dye lacquer produces the desired metallic tint and protects the silvered surface against oxidation and damage from handling.

Two other coatings have unique uses in work speedups. One is a quick-peel wallpaper paste (9) consisting of a 2% water solution of methyl cellulose; wallpaper hung with this adhesive can be peeled off in seconds once an incision has been made on its surface. The other is a styrene-butadiene coating (10) which covers "hot" wet plaster effectively. Both are tremendous timesavers in emergency production schedules.

Rising stars

Hollywood's most discussed plastics of the future are polyurethanes (11), which promise an unprecedented number of improvements in the studios. Uses predicted are astonishing. With them flexible, semi-flexible, or rigid forms can be fabricated (*To page* 268)

What about "membrane molding?"

New technique uses form-fitting, seamless, and transparent membrane in place of tailored bags in reinforced plastics fabrication

*By John Love**

Molding antenna housing: First, glass cloth is fitted on mandrel, then impregnated with polyester

Next steps: Form-fitting polyvinyl alcohol membrane is fitted over lay-up and excess resin scraped off

The forming of fibrous glass-reinforced plastics parts by vacuum bag molding is too well known to need more than the briefest description. It consists, essentially, in laying up resin-impregnated glass fibers over a suitably shaped tool and exerting pressure by drawing vacuum between the tool and an overlaid sheet of flexible material. The "bag" holds the plastic material in contact with the tool during the "cure" of the resin, producing a rigid part. Refinements in this process have been under continuous development by this company for the past five years. Because the developed process differs in many details from the original bag molding technique, we have called it "membrane molding."

By means of this technique it is possible to produce reinforced plastics parts which are equal in all respects, and in many ways superior, to those produced by any other process; it is possible to produce parts which cannot be made in dies; and it is possible to quote favorable prices, especially where premium quality is essential, where time is important, or where quantities are undetermined.

As noted, the membrane molding process is very much like bag molding. The principal difference lies in the use of a form-fitting, seamless, and transparent polyvinyl alcohol membrane in place of the "bag" which, being a flat sheet, accommodated the form through random wrinkling. This is roughly comparable to the difference between a bikini and a gunny sack. These membranes are not fabricated by joining tailored sections of flat sheet. They are made in one piece, entirely without joints, and to any contour required by a specific part. As a result, the membrane surface of the part can be as smooth and glossy as the tool surface. There is no necessity for subsequent removal

*Chief Engineer, Paul Omohundro Co., Paramount, Calif.

of the ridges left by wrinkles, nor any possibility of "kinked" plies in the reinforcement. The remainder of the process is very much like bag molding but with all steps brought to a high degree of refinement.

Translucent clarity

Use of a form-fitting membrane in conjunction with a suitable curing cycle results in polyester parts of translucent clarity. There is none of the whitening or opacity which can result from the use of heated molds. The parts may therefore be made void-free to an extent not possible with other processes. Porosity and water absorption, as might be expected, are unusually low. It has, in fact, been possible to make a small pressurized housing for electronic use having a wall thickness of only 0.017 ±0.002 in. and capable of holding air pressure under repeated temperature cycling. Attempts to make this part in matched dies failed because of porosity and migration of the reinforcing cloth. This was not a laboratory curiosity; more than 5000 of these parts have been fabricated with a reject rate on the order of 0.2 percent.

The combination of translucent material and polished surfaces benefits quality control. Trapped air, voids, dry fibers, fractures, foreign material, and most of the other causes of rejection which can occur as a result of the fabricating process are immediately apparent through visual inspection. There is never any doubt as to whether or not the part is acceptable. In addition, defects are under constant visual surveillance during the laminating process by reason of the transparent and form-fitting bag. As a result, the reject rate is low and the possibility of shipping bad parts in good faith is almost nil.

It might be supposed that the low pressure (about 12 p.s.i.) provided by vacuum cannot give a high ratio of glass fiber to resin. Experience has disapproved this. The data from a test panel, given in the (*To page* 271)

Physical properties of test panels[a]

Physical property	*Membrane molded test panel*	*MIL-P-8013 requirement*
Flexural strength, p.s.i.		
Standard condition	82,500	50,000
2-hr. boil, wet	80,200	45,000
Flexural modulus, p.s.i. × 10^6		
Standard condition	3.66	2.7
2-hr. boil, wet	3.42	2.5
Compressive strength, p.s.i.		
Standard condition	47,600	35,000
2-hr. boil	42,800	30,000
Tensile strength, p.s.i.		
Standard condition	47,000	40,000
2-hr. boil	43,400	38,000
Ignition loss, % resin	30.6	
Specific gravity	1.90	
Barcol hardness	74	

[a]The data above are from certified tests on a ⅛-in. test panel. The panel was made from 13 layers of 181-RS49 glass cloth, impregnated with Selectron resin 5003, for conformance with MIL-P-8013. The panel was produced by Paul Omohundro Co. shop personnel.

Hemisphere 10-ft. in diameter, fabricated of membrane molded polyester parts, is highly translucent: ribs at right are *behind* ⅛-in. outer skin. (Photos, Paul Omohundro Co.)

Latest landing craft

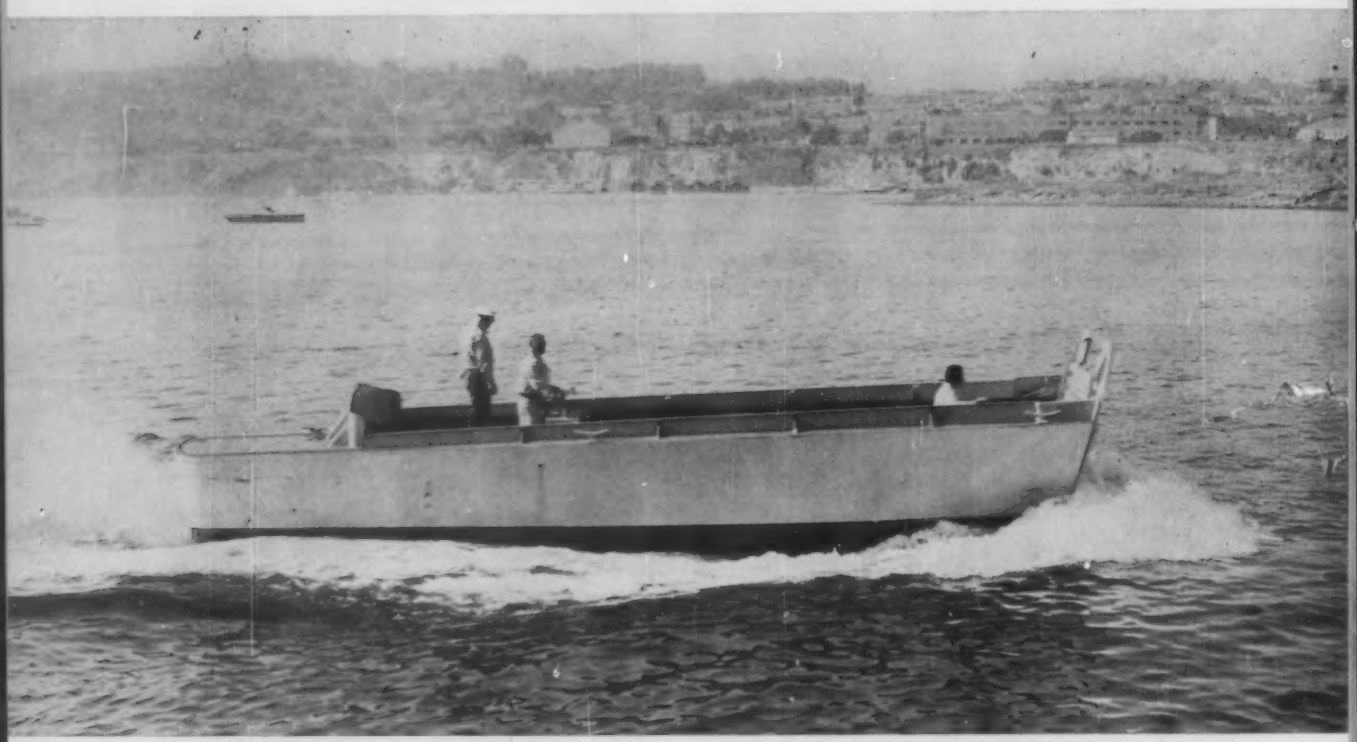


Fig. 1: A reinforced plastic waterjet LCVP operating at cruising speed

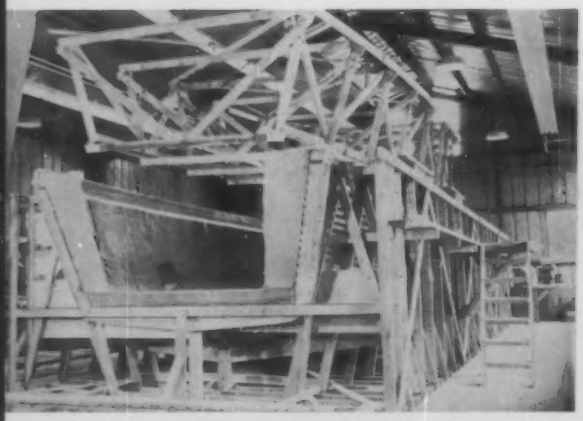


Fig. 2: Boat hull in wooden mold, ready for installation of internal shoring before removal from mold. Note hooks for securing honeycomb to mold along bottom and sides

Fig. 3: Close-up of an installation of the spring-loaded hooks used to snug up the honeycomb core to the wood ribbands of the hull mold frame. (All photos with this article, Zenith Plastics)

By the use of a wooden frame for a mold, waterproof honeycomb made from laminate, a special blend of resins, and a lot of ingenuity, the first waterjet LCVP's are quickly built

*By John W. Marzicola**

Drop an 18,000-lb. LCVP (landing craft, vehicle, personnel) 20 ft. into the sea from an attack transport and bang it against the side of the ship a couple of times before dropping it, and you have a typical launching.

And after it has been thrust hilt-deep on the beach, make it retract itself as quickly as a crawfish and speed back to the transport for more men and materials. For an LCVP (Fig. 1), this is normal operation.

For some years now the Bureau of Ships, U.S. Navy, has been conducting experimental construction and test programs on reinforced plastics landing craft because high impact resistance and immunity from attack by fungus, worms, rot, and salt water are basic requirements.

Zenith Plastics Co., a subsidiary of Minnesota Mining & Mfg. Co., was asked to design and build two reinforced plastics waterjet LCVP's for evaluation. These big boats should provide answers to two questions: 1) Will they have a decided advantage over wood and/or metal boats when considering strength, minimum maintenance, and ease of repair, and 2) will the waterjet principle provide an assault landing craft that meets all the performance requirements of propeller driven boats and yet allow for quick retraction from beachings under all conditions?

*Project Manager, Marine Facility, Zenith Plastics Co., subsidiary of 3 M, Gardena, Calif.

Tooling cost kept low

Since Zenith was required to build only two of these new type boats, tooling cost had to be kept to a minimum. It was decided that all the molds would be fabricated of wood. The

Fig. 6: Fabrication of a cargo flat, showing detail of 6-in. paper honeycomb. These flats are made in two halves and are joined over the centerline girder

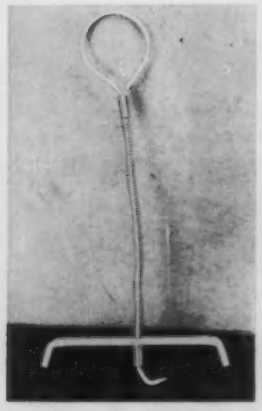


Fig. 4: Detail of spring-loaded hook shown in Figs. 2 and 3 on opposite page

Fig. 5: Lay-up of 3-in. honeycomb for centerline hull girder. At top of girder is cellular cellulose acetate strip to give increased bearing strength

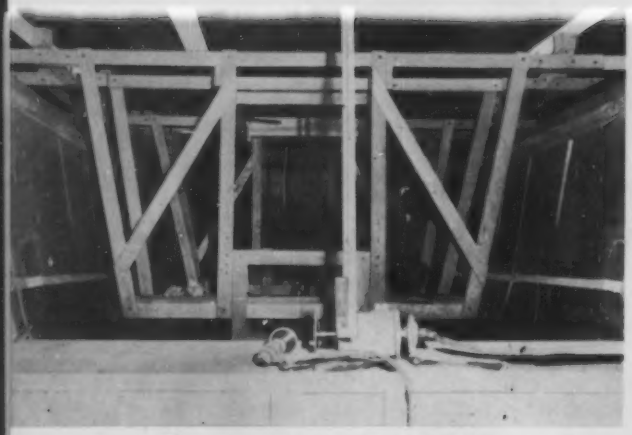


Fig. 7: With internal shoring in position, final inspection is made of honeycomb and cellular inserts

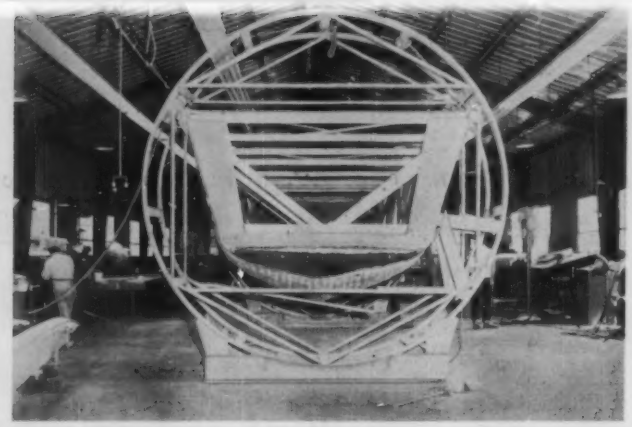


Fig. 8: Hull in turn-over fixture, ready for inverting and placing of exterior skins

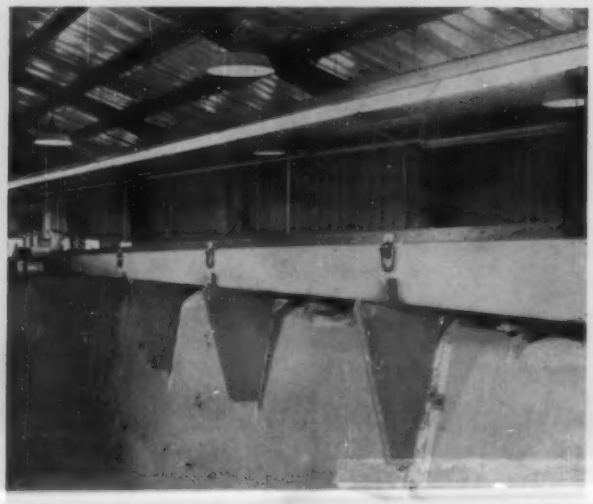
main hull mold was constructed basically of 2-by-4 framing lumber. One-half-inch plywood frames for controlling the hull contour were spaced approximately 2 ft. on centers. Although the Small Boat Design Section of the Bureau of Ships had designed this boat with rounded chines and corners, the sides from the waterline up were straight. This was done to simplify fabrication and provide a flat surface for the installation of the armor plate. Therefore, the side contours of the hull mold were maintained by 2-by-4's. The radii of the plywood bottom frames faired into the sides. Then 1-by-2 Douglas Fir strips were nailed to the frames longitudinally, approximately 4 in. on centers, to complete the mold. In short, the mold was a low-cost, simple containing frame, as may be seen from Fig. 2.

The hull structure itself was designed to eliminate the need for frames and stringers. Inherent stiffness was achieved by making the hull a sandwich-type structure. Over-all sandwich thickness is approximately 3½ inches. The core material for the sandwich is a 3-in. paper honeycomb. A new type paper honeycomb was developed for the plastic LCVP's by Douglas Aircraft Co. and Continental Can Co. Since the possibility existed that damage to the exterior skin would allow water to invade the core area, a paper honeycomb had to be developed that would inhibit water migration. To effect this, a paper was designed using a 15-mil plastic center. Zenith used Douglas' waterproof paper honeycomb, Style 115-45, Type 20. The paper for this honeycomb is made by bonding two layers of 50-lb. kraft to a 15-mil polyvinyl core. The paper is then made into the honeycomb structure and is surface-treated by dipping it into a bath of phenolic resin, and curing. Douglas then has a paper honeycomb that has approximately 45% phenolic resin surface impregnation. This honeycomb forms the base of the hull structure and decks.

Figure 3 illustrates the Zenith method of

Fig. 11: Replaced in the turn-over fixture, the completed hull is turned right side up

Fig. 12: Cargo compartment, showing reinforced plastics coaming and integral brackets



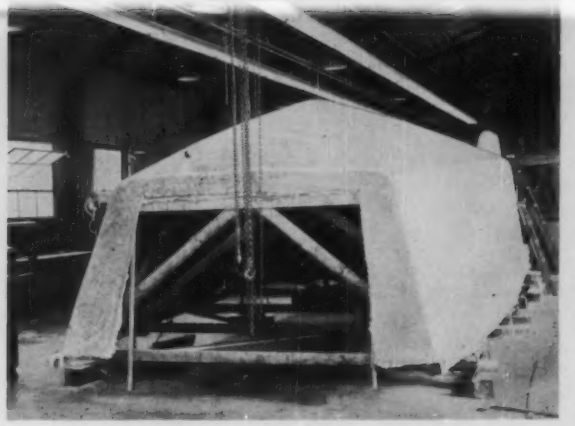


Fig. 9: Bow section of hull. Exterior laminates have been applied and sanded smooth

Fig. 10: Before painting the hull, metal section is installed, which provides foundation for and is part of waterjet unit

securing the honeycomb to the hull mold frame by means of spring-loaded hooks, such as the one in Fig. 4, which snug up the honeycomb to the wood ribbands.

CCA water barriers

The hull core is divided into five areas by means of cellular cellulose acetate water barriers to give additional safeguard against water migration and to provide areas for through-hull bolts in securing armor plating to the hull. These CCA water barriers are 3 in. thick.

After all the waterproof paper honeycomb has been fitted to the mold and the CCA barriers inserted, the interior skins are laminated to the core. The first ply of cloth, which is the bond layer, is heavily impregnated with a thixotropic polyester resin. The edges of the paper honeycomb receive a coating of the laminating resin, applied with a sheepskin paint roller. After the bond layer has been secured to the core, five plies of woven roving are applied, the woven roving being pre-impregnated with the laminating polyester resin in a roller and bar scraper impregnating machine. The resin is specially blended and consists of 70% general purpose laminating resin, 20% thixotropic resin, and 10% flexible resin. This formula was found to be the most satisfactory for the LCVP's.

After the interior skin is allowed to cure at room temperature, the plastic centerline girder (Fig. 5), bulkhead, and cargo flats (Fig. 6) are installed. The girder is also a 3-in. paper honeycomb core sandwich. It extends along the centerline of the hull from the bow to the watertight bulkhead separating the engine room from the cargo compartment. This bulkhead is a 1-in. honeycomb core sandwich. The centerline girder supports the cargo flats and backs up the keel during beaching. The cargo flats have 6-in. paper honeycomb cores and are made in two halves. They are joined over the centerline girder and have molded flanges along the

Fig. 13: Aft deck mold, with 2-in. honeycombs and cellular acetate inserts fitted in place

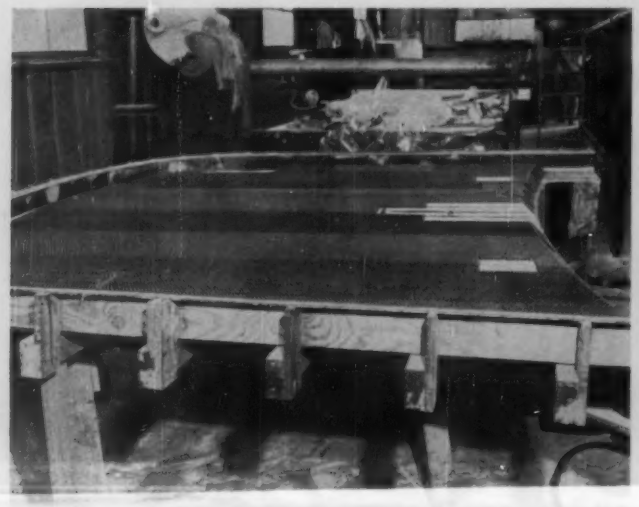


Fig. 14: Laying up the top plies of the aft deck, of which splash board is integral part

sides and aft section for bonding to the hull and bulkhead. These flats and the bulkhead form a watertight buoyancy chamber.

Upon completion of the installation of the cargo flats, girder, and bulkhead, the wooden internal shoring is installed (Fig. 7). The purpose of the shoring is to provide additional rigidity to the hull structure and to facilitate removal of the partially completed hull from the mold. The hull is next placed into a huge turn-over fixture and inverted (Fig. 8). All surface irregularities are sanded smooth, and the corners and chines filled with a mixture of vermiculite and thixotropic resin. Now the hull structure is completed by applying the exterior plies to the paper honeycomb, as shown in Fig. 9.

The exterior laminate is sanded smooth and painted with a pigmented epoxy resin. After this resin cures, an anti-fouling red paint is applied below the waterline. Before painting the exterior hull surface, the metal hull section which supports and is part of the waterjet pump unit, is fitted. (See Fig. 10.) The hull is once again placed into the turn-over fixture and righted as shown in Fig. 11.

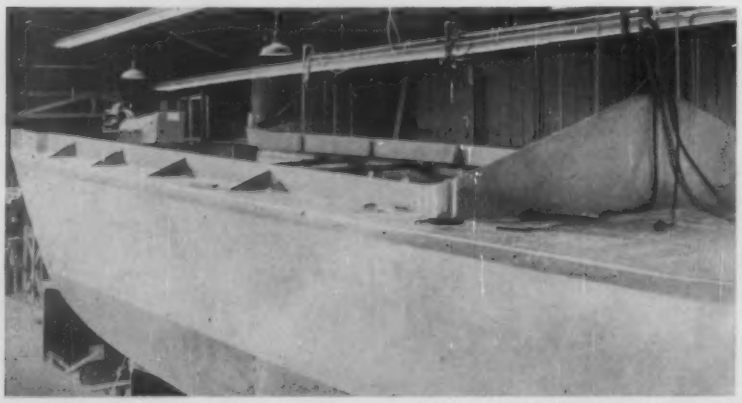
The final phase of fabricating the 36-ft. plastic waterjet landing craft consists of the installation of the plastic coamings (Fig. 12), the plastic aft deck (Figs. 13 and 14), and completely outfitting the boat. The port and starboard coamings were laminated in a wood mold in one piece and separated after curing. The metal coaming braces used on the wooden LCVP's were eliminated and plastic braces were molded as an integral part of the coamings. The coamings are room-temperature cured. The aft deck is fabricated in a wood mold and the splash board layed up as part of the aft deck. The deck was designed with a 2-in. wide flange which caps over the stern section of the boat. This allows the deck to be removed for easy access to the pump unit. Figure 15 shows the completed hull prior to inspection.

Plastics in the waterjet

Reinforced plastics were liberally used in the construction of the waterjet. However, prudent use of plastics was made and if wood or metal had particular advantage over reinforced plastics for certain applications, these materials were used.

A major concern in the design and development of the plastics waterjet was the elimination of water from the honeycomb cells. Although a paper honeycomb has been developed to prevent water migration, there remains somewhat of a problem in water seepage through the skins. Extreme caution was taken to insure watertight skins on the hull structure. A considerable amount of research was conducted on various types of water barriers, interlaminated between the plies of woven roving. Some of the materials investigated were fibrous glass paper and the water barrier kraft paper used for making the paper honeycomb. Both of these were successful and could be used if, under extended service, water seepage through the outer skins becomes a problem. At the present time Zenith is also experimenting with various other types of core materials such as foams, balsa, cork composition, etc., as well as with other types of reinforcements, including specialty fibrous glass, mineral filaments, and organic materials.

Fig. 15: Completed hull, with aft and side decks installed



Hot-water bottles now in polyethylene

Modern progress has now successfully overtaken even the conventional red rubber hot-water bottle — in the form of a durable, long-lasting, attractive bottle blow-molded of polyethylene.

This new concept of an item which has heretofore been in the classification of "rubber goods" is a development of Vantines, Inc., Long Island City, N.Y.; custom blow-molding is by Royal Mfg. Co., Inc., Prescott, Ariz., a company that has long specialized in unusual molding jobs.

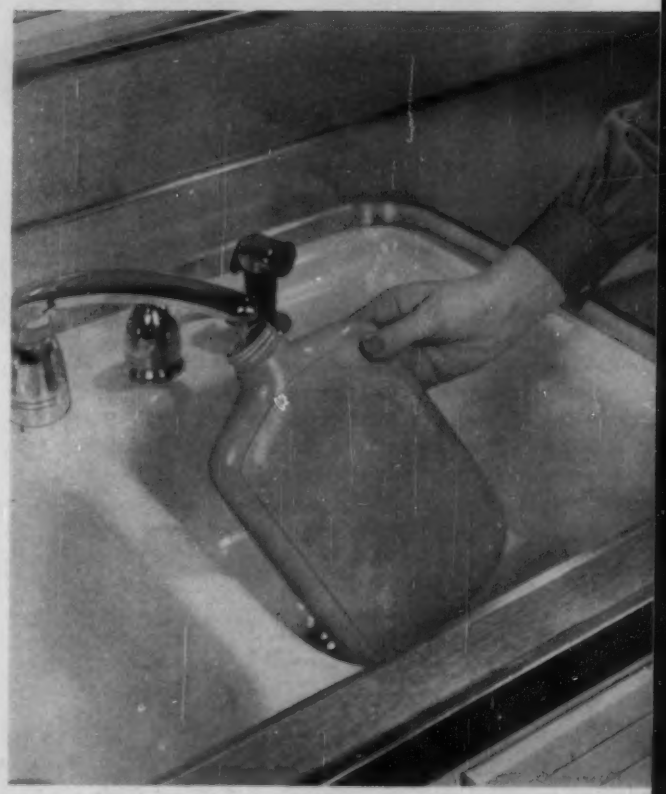
Twenty-five year guarantee

The advantages which the polyethylene hot-water bottle offers over the rubber product are important enough to assure the plastic model a healthy chunk of the $20 million annual retail business that exists today for hot-water bottles. Blow-molded in one piece, the polyethylene bottle has no seams to open or fall apart. It is about 60% lighter than a rubber bottle and it retains heat longer. Since it is chemically inert and cannot rot or otherwise deteriorate, Vantines merchandises each bottle with a 25-year guarantee. Heretofore, manufacturers of even the most expensive rubber hot-water bottles never dared to offer more than a 5-year guarantee.

Where the polyethylene bottle has one of its biggest edges over rubber is in its attractive appearance and obvious consumer appeal. Royal blow-molds the bottles for Vantines in six attractive colors, with a handsome criss-cross pattern on the exterior surfaces.

Although it is molded of polyethylene, a thermoplastic, the bottle can be filled with hot water without becoming permanently distorted or warped. As a matter of fact, Vantines was encouraged to begin the project on the basis of its success with a blow-molded polyethylene baby nursing bottle that was subjected daily to hot water.

In addition to the hot-water bottle, Vantines markets a fountain syringe and a combination hot-water bottle and syringe based on the same polyethylene construction.



Blow molded polyethylene hot-water bottle combines merchandising appeal of color with long service life. (Photos, Vantines)

Similar polyethylene construction is used for syringe (center) and syringe-hot-water bottle combination (left). Tubes for syringes are extruded of vinyl

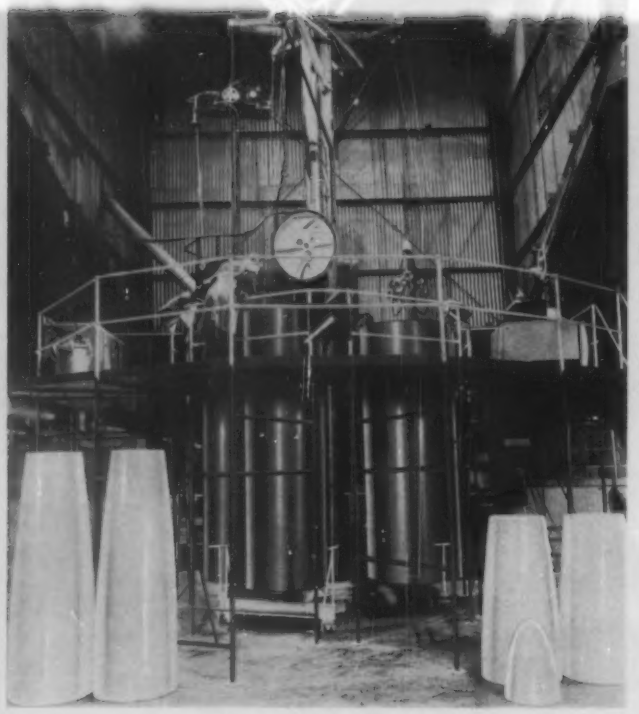


Fig. 1: Automatically controlled centrifugal action machine is used in spin molding process. Here the machine is being operated with three shrouds (bell jars). Total capacity of machine is six shrouds operating at one time, each in a different phase of the operation, i.e., forming, bagging, raising temperature to cure temperature, curing, cooling, and removal of part

Fig. 2: Typical parts: drop tank (top), missile container (right), radomes

Spin molding reinforced polyesters

Semi-automatic centrifugal process molds stronger, more uniform radomes and tanks at lower cost

*By E. C. Mireau**

A new reinforced molding process preforms and molds radomes and similar shapes in a single, automatic operation. Glass fiber and resin are sprayed onto the inside surface of a spinning mold to get uniform distribution of resin and glass. Curing is done later in the process, which operates in six stages on a revolving frame (see Fig. 1).

The development of the process was inspired by the need for expendable drop tanks for jet aircraft. Aside from being heavy, metals are likely to be in short supply during wartime, when these tanks would be needed in great numbers. A logical material seemed to be polyester-glass, low-pressure laminates, but existing methods of production gave neither the economy nor uniformity of production wanted. The present centrifuge-type machine has been under development at Pastushin Aviation Corp. for over five years and is now entering into the commercial production of drop tanks, radomes, cylindrical containers, etc. The new process permits higher production rates than older methods and provides a more uniform mat structure with a high glass content (60 percent). Physical properties obtained (see Table I) are substantially higher than those of moldings having the same composition but made in matched metal molds from mat.

*Manager, Plastics Div., Pastushin Aviation Corp., Los Angeles 45, Calif.

Table I: Mechanical properties[a] of centrifugal glass-reinforced polyester moldings

Property	*Average of 5*	*Range of 5*
Tensile strength[b], p.s.i.	17,200 (13,600)[c]	2,500 (3,700)
Compressive strength, edgewise, p.s.i.	23,300 (15,500)	2,600 (2,100)
Flexural strength, p.s.i.	30,700 (22,500)	3,500 (3,300)
Flexural modulus, flatwise, 10^6 p.s.i.	1.51 (1.24)	0.19 (0.36)
Resin content[e], %	39.34[d]	0.28[d]
Specific gravity	1.77[d]	0.01[d]

[a]Testing was done by United States Testing Co., Inc., Hoboken, N. J. Strengths are based on original cross sections; five specimens were tested in each mechanical property test.

[b]Test methods were those of Fed. Spec. L-P-406b. Tensile was done according to Method 1011, compressive by 1021, flexural by 1031, specific gravity by 5011. Resin content was measured in accordance with MIL-P-8013a, para. 4.2.2.1.2.

[c]Numbers in parentheses are results of testing after the specimens were boiled 2 hr. in distilled water.

[d]Averages and ranges for 3 specimens, not 5.

[e]Resin used was General Electric's AR403, with a styrene content of 27%. Roving was Owens-Corning 2-in. PC 851.

The nature of the process restricts the shapes to surfaces of revolution or other shapes reasonably close to them (e.g., shapes of elliptical cross section with major and minor axes differing by 20 percent or less). Walls having molded thicknesses up to ½ in. can be held to ±10 percent in thickness; also, sections having local variations in wall thickness, such as ribbed sections, can be automatically formed. Very large pieces can be made—the size is limited only by the size of the shroud that the machine can handle. In the present machine the piece dimensions will be limited to about 10 ft. in length and 4½ ft. in diameter. The largest shroud now available, 48 in. in diameter, can make 44-in. pieces. Pieces having diameters less than 8 in. must be preformed in a separate machine, which is also used to preform cone-shaped pieces with inside tip radii of 2 in. or more. Typical shapes are shown in Fig. 2.

After the glass and resin have been sprayed onto the spinning mold, the shroud, whose construction features are shown in Fig. 3, advances to the second position. Here a vacuum bag is placed in the mold (see Fig. 4) and vacuum is applied from outside the mold. (The shroud serves as a giant bell jar.) At the next position, the mold is heated to curing temperature. Curing takes place at position 4, and at stage 5 the mold is cooled and the bag removed. Finished parts are pulled from the mold by applying a flash heat that raises the shroud temperature 350° F. in 3 minutes. Resulting mold expansion, aided by a parting agent, frees the part so that it can be lifted out with suction cups (Fig. 5).

A single unskilled operator can turn out about 12 parts per hour. Tooling costs are low, tooling lead time is about 45 days.

Fig. 3: Interior view of shroud, showing general construction

Fig. 4: Inside view of mold encased in shroud during bagging operation; templet is used to center mold in shroud

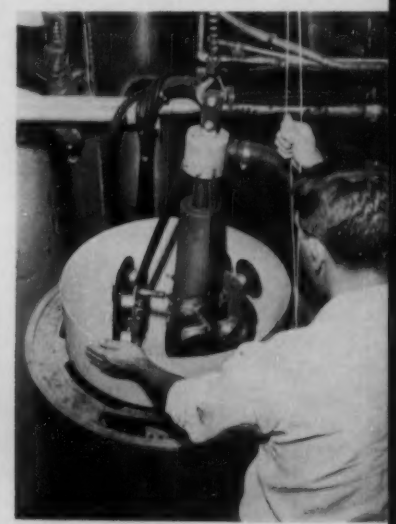
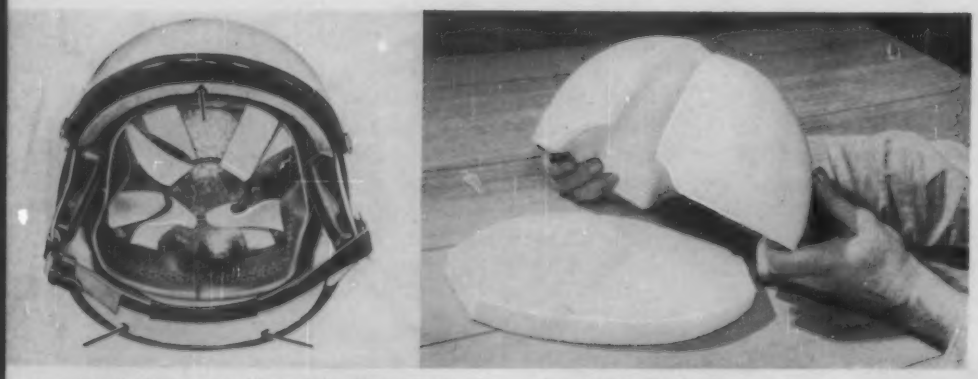


Fig. 5: Finished molding has just been raised out of mold

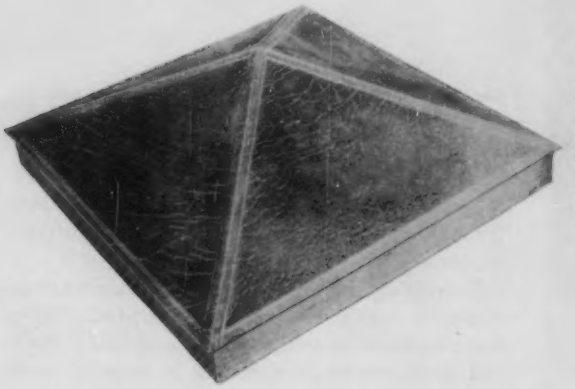
Pacific Coast plastics products

Increasingly, plastics proprietary items designed and produced in the Far West are gaining national distribution



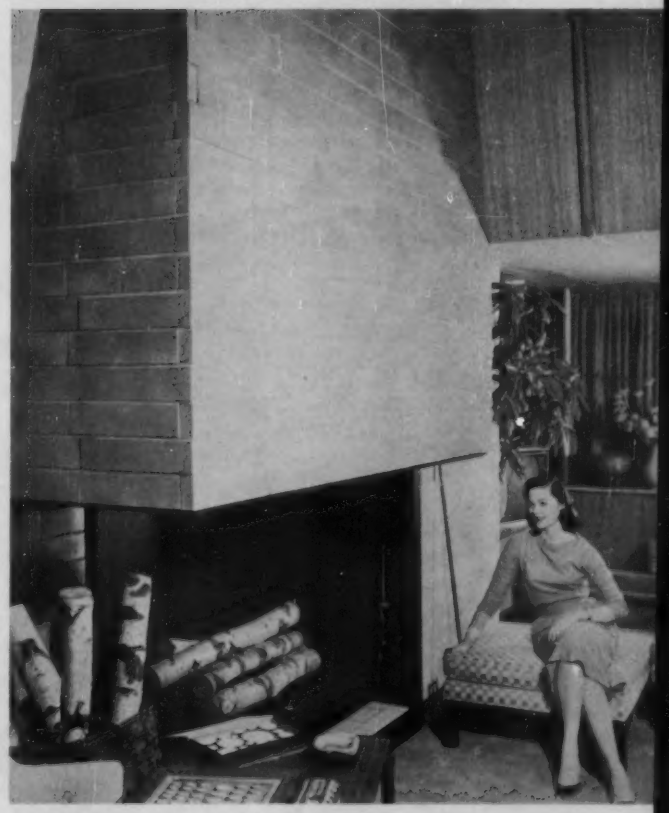
Technique developed in the West for postforming foamed plastics sheet stock is used to make liner for policeman's reinforced plastics helmet (left). Liner is formed in two halves (right), cemented together. (Photos, Techniform)

Presence of lumber industry in Pacific Northwest has stimulated interest in use of resin-bonded granulated wood molding compounds. Serving tray, right, is molded of wood fibers blended with dry melamine-urea resin. (Photo, American Cyanamid Co.)



Offshoot of Pacific Coast's emphasis on reinforced plastics is formed polyester resin-fibrous glass skylight. Translucent unit is low in cost, durable, and easy to install. (Photo, Everlite Corp.)

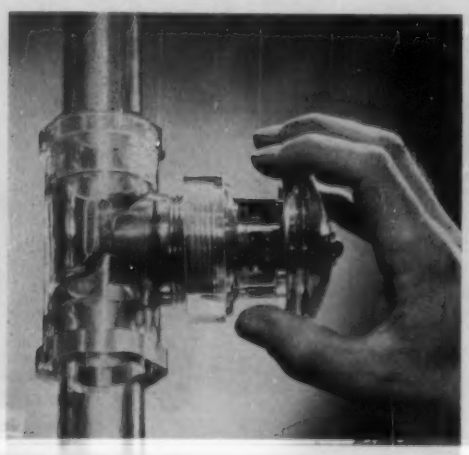
Cement blocks for decorative fireplace have surface coating of polyester resin and fibrous glass. The smooth, colorful, and durable coating is scratch resistant and fadeproof. (Photo, U. S. Rubber)



From the standpoint of plastics product development, the only regional characteristic which today's Western manufacturers seem to have in common is the fact that there are few that still operate on a regional footing. To understand this seeming paradox, one must first take into account the fact that manufacturing has virtually doubled on the Pacific Coast in the past ten years.

The results of this aggressive growth have been twofold. First, national companies with headquarters in the East and Mid-West have been induced by the booming Western consumer markets to set up an increasing number of branch factories in the area, pumping new life into the Coast's industrial bloodstream. Second, those homegrown industries which originally turned out plastics products strictly for sale in their own back yard have started to move in the opposite direction, branching out into sales on a national basis.

Alsynite Co. of America, with headquarters in San Diego, Calif., is one outstanding example of the latter type of industrial movement from West to East. Although Alsynite's corrugated and flat reinforced plastics panels found their original outlets in the West Coast areas, where emphasis on outdoor living boosted sales of the material for patio roofs, the com-



Globe-type valve introduced by California company is molded entirely of transparent butyrate, permitting flow of liquids to be readily observed. The butyrate valve can never rust and will resist the corrosive action of many chemicals. (Photo, Eastman Chemical Products)

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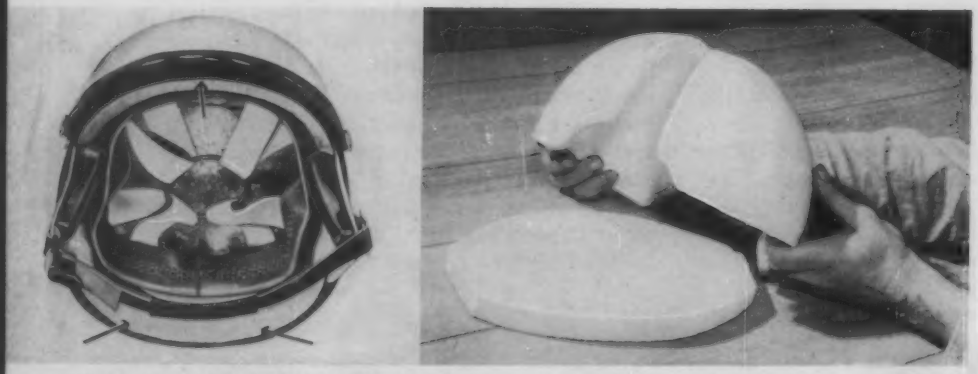

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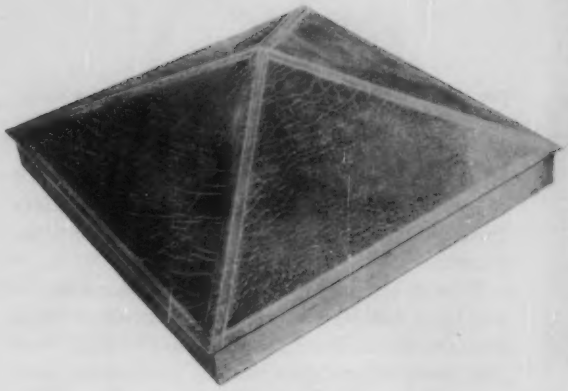

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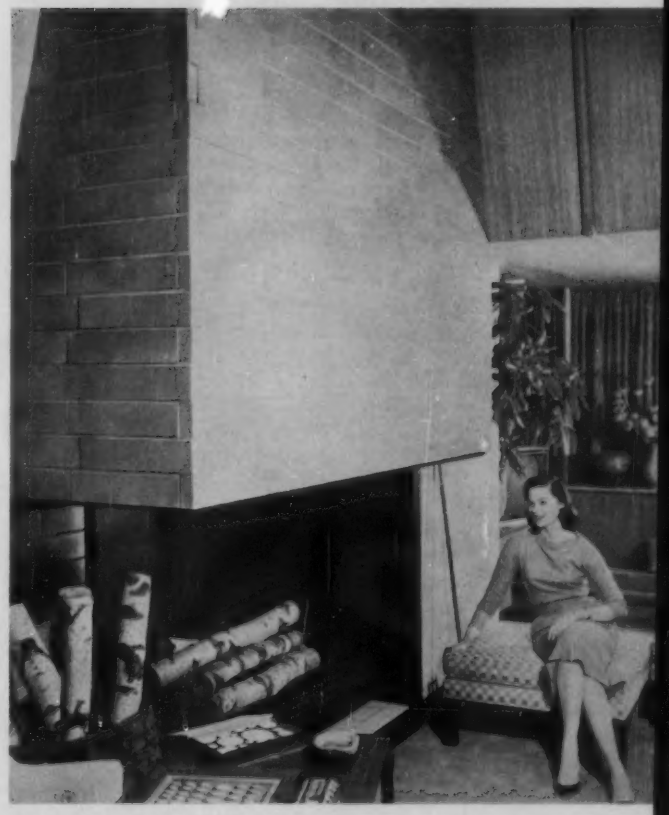

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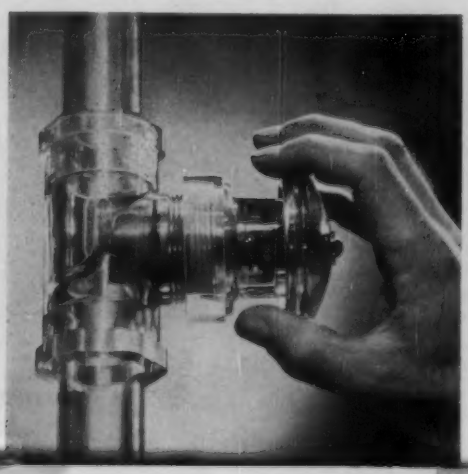

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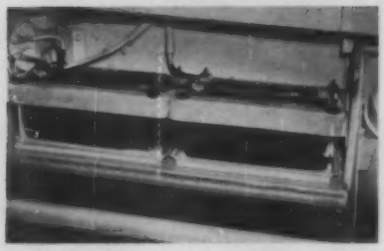


Lightweight, corrosion-resistant reinforced plastics battery hold-down and tray (top) are used by truck manufacturer in 12-v. installation (bottom). Parts are made by hand lay-up. (Photos, A.I.M. Plastics)

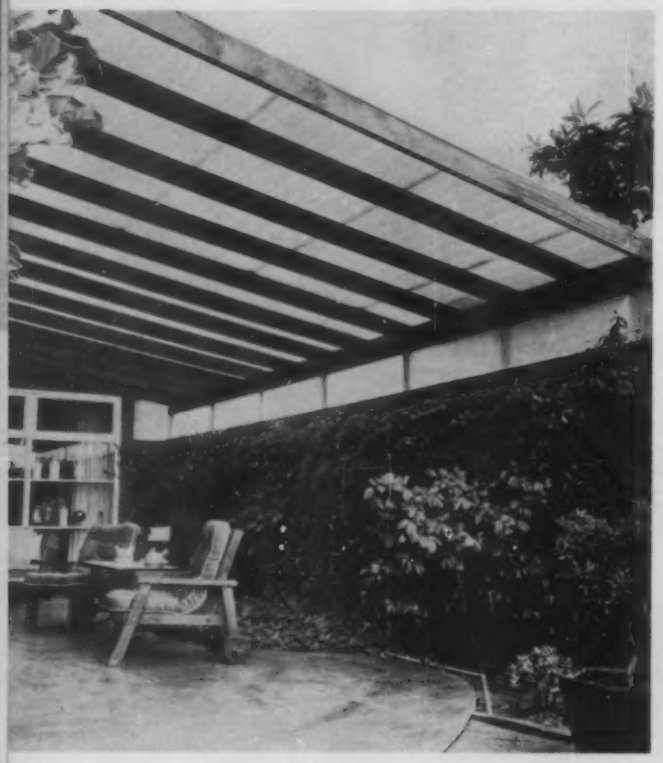
pany has now expanded into a national organization with manufacturing plants in Portsmouth, Ohio, and Paterson, N. J. Marketing is done through a distributor-dealer network of some 200 distributors and 6000 dealers throughout the United States and 20 foreign countries.

Even Western manufacturers of housewares and toys, despite the handicap of distance from the traditional buying centers in the Mid-West and East, are now beginning to operate on a national footing. Especially noteworthy in this respect has been the outstanding market development work being done out on the Coast with such items as large polyethylene housewares and toys.

Western plastics products

The types of plastics products that the West has been sending out to the rest of the country are many and varied. The bulk of them have been spawned by four huge industries of the West Coast—aircraft, lumber, agriculture, and electronics. These industries gave initial encouragement to Western plastics product development work and, in so doing, they stimulated plastics manufacturers to experiment with new materials and new plastics processing techniques.

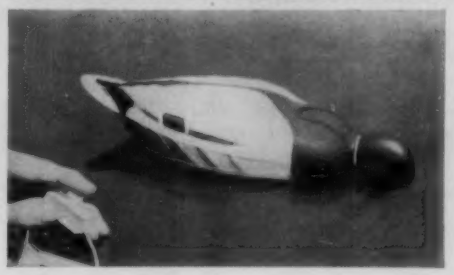
But to the presence of these huge industries



West Coast emphasis on outdoor living originally helped boost sales of corrugated reinforced plastics panels as patio roofs—but distribution is now on a nation-wide basis. (Photo, Alsynite)

Reflecting a wide-spread interest in the bizarre and the unusual is a model "Jivaro shrunken head" slush molded of vinyl plastisol. (Photo, E. Joseph Cossman)

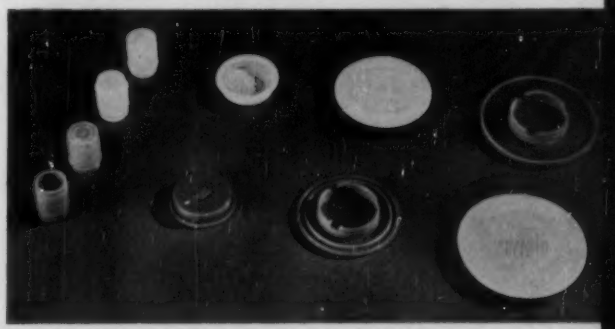
Molded butyrate mechanical decoy duck, operated on a 4½-v. battery, goes through actual feeding motions by bobbing its head in and out of water. (Photo, Eastman)



cannot be given all the credit for product development. In a sense, much of the Western plastics industry seem to have inherited the pioneering spirit of the early settlers. As already noted, a good deal of the early work with large polyethylene pieces, in both housewares and toys, was done on the Coast. The rest of the country even now is starting to reap the benefits of the Western states' experiments with plastics film and plastics pipe for argicultural purposes. And in fabulous Hollywood, the experience of set designers in using polyester-glass laminates, foamed plastics, and thermoformed plastics pieces is beginning to revolutionize many aspects of the sign and display field. The special personality of the Westerner, including his penchant for outdoor living and outdoor sports, his devotion to leisure-time activities, and his attraction to the new, the unusual, and the bizarre, is another factor affecting product development.

In the survey of West Coast applications which follows, it will be seen that the majority

Plugs for metal beer kegs are all molded of polyethylene. In contrast to cork plugs, the plastic models are tasteless, can't chip or crumble, and hold fast despite exposure to cold or heat. (Photo, Denver Plastics)



Sports-conscious Pacific Coast industry is now turning out for water skiers an inflatable safety belt fabricated of 12-gage vinyl sheeting. (Photo, Plastimayd)

Molded high-impact styrene portable carrier for phonograph records can handle up to 90 records yet, when completely full, weighs only 10 pounds. (Photo, Wilcox Plastics)

of applications have their foundation in one or a combination of two or three of the dominating factors listed above—the presence of huge industries, the pioneering spirit, and the way of life of the Westerner.

Results of aircraft applications

The immediate results of the West Coast plastics industry's association with the aircraft industry has been sensational developments in the fields of reinforced plastics (see "Four hectic months!" MODERN PLASTICS *34*, 104, Feb. 1957), sandwich constructions, foamed plastics, and, most recently, high-heat-resistant plastics. An example of one instance where a product developed for the aircraft industry has proved to have other commercial applications, is found in the activities of Techniform, Inc., Van Nuys, Calif. The company has developed a technique for post-forming foamed styrene, or foamed acetate board, or sheet stock by compression molding. Originally, the technique was used for an aircraft application—pressure forming a Rocket Pod Frangible Nose Cover of Dow's Styrofoam—but the company has now extended its activities to the forming of helmet liners (photos p. 154) and parts of flying model kits, using Styrofoam or Strux's cellular cellulose acetate material. And since the technique makes it possible to form flat sheet foam stock into a wide variety of curves and contours, additional possibilities are foreseen.

Bumper pads for unloading rolls of newsprint at dockside are made up of tapered wedges of polyurethane foam covered with vinyl-coated nylon case. Pads can be handled by one man. (Photo, American Latex)

Also in the area of aircraft activity, the rest of the country is anxiously awaiting the results of the research now going on out on the Coast on new tough, heat-resistant plastics. Unfortunately, since most of this work is being done in connection with the design of fast fighter planes and long-range missiles, most activities are cloaked in secrecy. Once full results have been revealed, however, all indications point to the fact that plastics will have an exciting new dimension in which to work. Zenith Plastics Co., a subsidiary of Minnesota Mining & Mfg. Co., Gardena, Calif., for example, reports that plastics radomes on some of our new fighters can withstand temperatures up to 500 to 600° F.—and research is already aiming at 1000° F. At 600° F.; these new plastics are now stronger than titanium. Zenith also states that 15% of one ICBM (Inter-Continental Ballistics Missile) is covered with plastics materials and that, with a little further development, plastics might cover some 90% of the structures.

Realistic molded polyethylene branches and a molded styrene trunk make up an easy-to-assemble Christmas tree that cannot wear out, dry out, or rot. (Photo, Warren)

Plastics + wood pioneering

The second great industry of the West—plywood—has long been an excellent market for such resin bonding adhesives as resorcinol formaldehyde, resorcinol phenol-formaldehyde, and urea formaldehyde. More recently, there has been considerable emphasis on using these resins to bond granulated wood that could then be molded into a finished product. Ability Products Co., Pasadena, Calif., for one, blends wood fibers and American Cyanamid's Melurac melamine-urea resin adhesive to form a compression molding com- (*To page* 274)

Braided nylon-reinforced vinyl hose is weather resistant, highly flexible and kinkproof. (Photos, The Borden Co.)

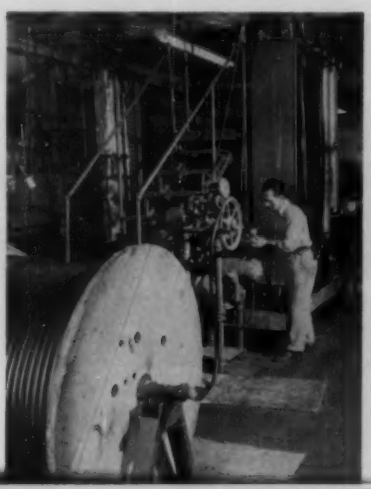
3 steps to better hose

The manufacture of vinyl garden hose for semi-tropical climates is not too difficult. Needed is sunlight resistance, heat stability, and normal resistance to abrasion. But to produce a garden hose for national distribution and for use in all temperature ranges and under all conditions of physical abuse, is a more difficult matter.

A new hose built to withstand exceptionally high water pressures, a wide range of temperatures, and tough usage has been developed by The Resinite Dept. of The Borden Co., Chemical Div., in Santa Barbara, Calif. This hose is made in three separate steps. The core is an extrusion of polyvinyl chloride formulated for smoothness and flex. Over this extruded core are automatically braided 12 strands of nylon cord, after which a patented process is used to heat the hose core, imbedding and tightening the braiding cords into the wall. Finally, a shiny green abrasion-resistant plastisol is extruded over the braided surface.

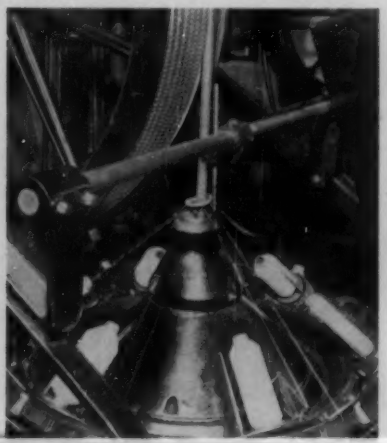
By braiding the nylon cord without stretch or strain, maximum reinforcement is obtained.

The hose, which is declared to be about ⅓ the weight of a rubber hose, is weather-resistant, flexible in a wide range of temperatures, and kinkproof. Each production unit is tested to stand water pressures many times those found in available household systems.



Extruded close-tolerance vinyl tubing core is wound on high-capacity reels for transportation to site of braiding operation

Core is reinforced with nylon braid



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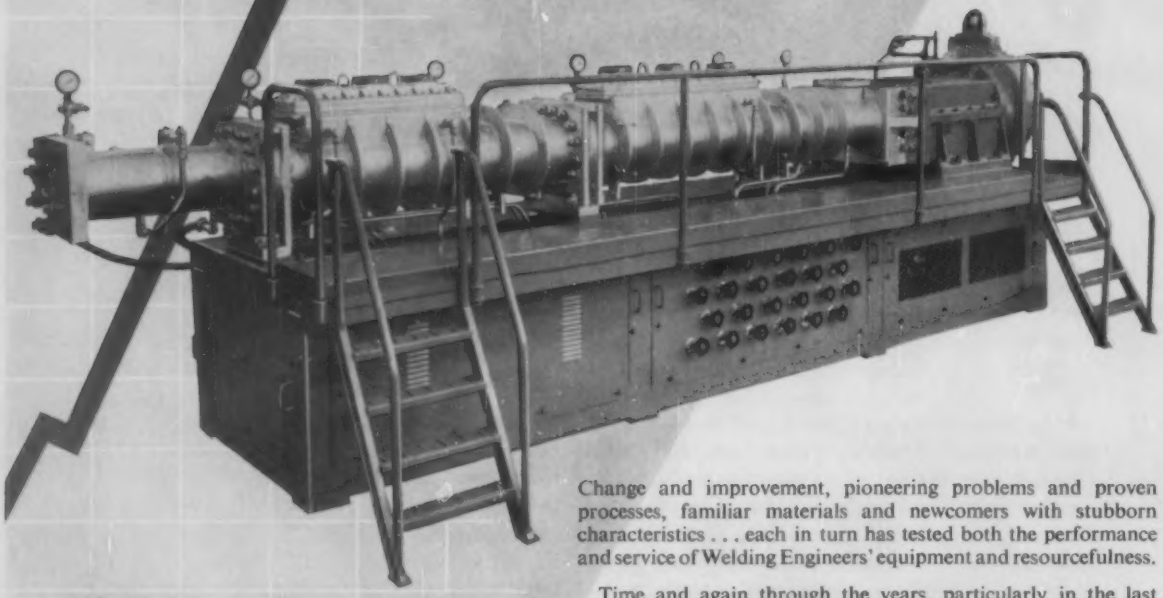

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☆See Modern Plastics January report on "1956 Progress and prospects 1957"

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WELDING ENGINEERS INC., Norristown, Penna.

Dr. James F. Carley, Engineering Editor

Cross-sectional view of corner of container for electronic gear made by pressure preforming process. Note taper of profile from top to bottom and from center to outside. Heaviest section at corner gives impact strength and rigidity where most needed, while bottom and walls can be made thinner. (Photo, General Electric Co.)

Pressure preforming

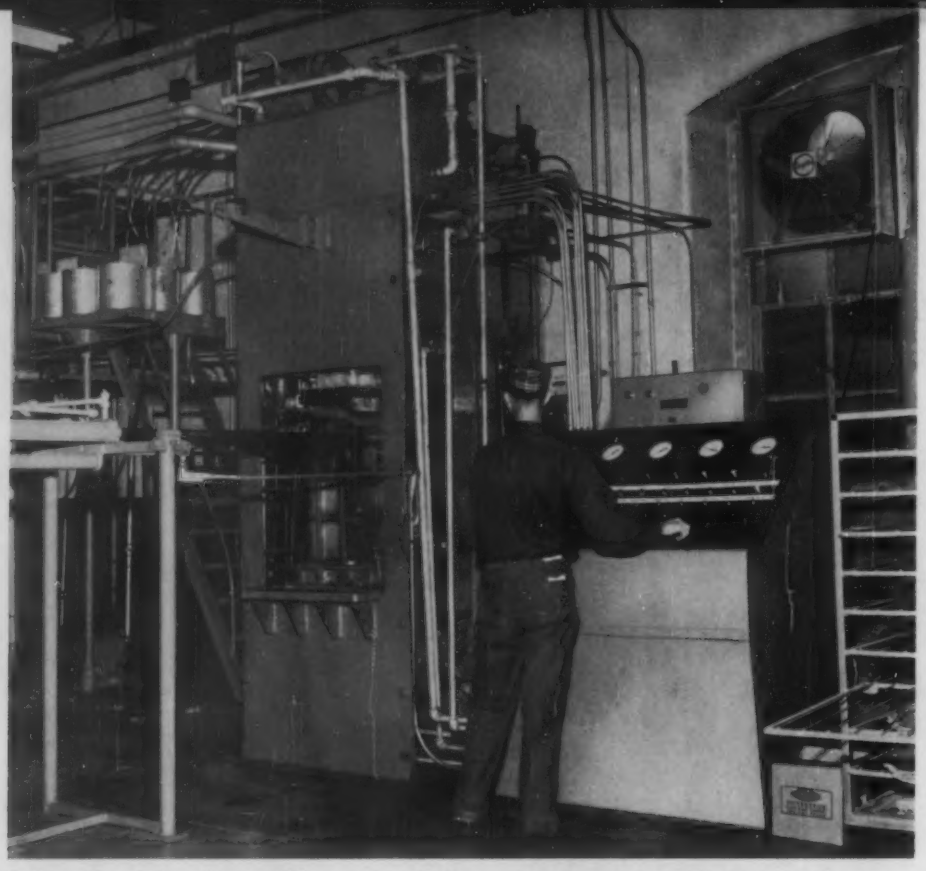
A one-step preforming process makes precision preforms of sharply varying cross section quickly and without waste

By S. H. A. Young†

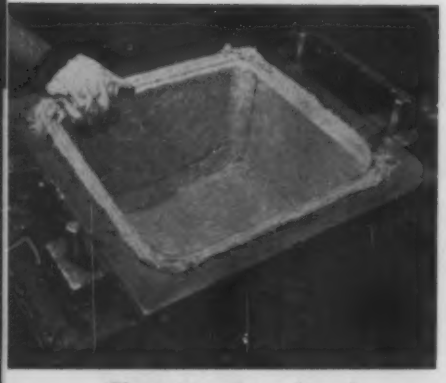
Major obstacle to much wider use of fiber-reinforced plastics has been the high cost of making articles from these materials. For many applications, fibrous glass reinforcement provides better mechanical properties than are needed and unnecessarily increases the cost. This has resulted in the introduction of cellulosic and synthetic fibers as reinforcing agents, many of them much cheaper than fibrous glass on a volume basis. (See "Reinforced molding compounds," MODERN PLASTICS *33*, 91, Aug. 1956 and *34*, 155, Oct. 1956.)

A big cut in the cost of producing many reinforced plastics articles came with the introduction of automatic preforming methods. These involve the suspension of chopped fibers in either air or water and their subsequent deposition on a preform screen. The air-suspension method is limited by the difficulty of getting even distribution of the fibers. In the previous water-suspension method (see "The how and why of slurry preforming,"

° Reg. U. S. Pat. Off.
† Director of Engineering, Pressurform Co., Swarthmore, Pa.



Automatic preforming machine used in the Pressurform process for making reinforced plastics articles. The slurry containing chopped glass roving is forced against the screen in the preforming mold (visible near bottom opening in cabinet to operator's left). Just emerging from machine is finished preform of a side section. (Photo, General Electric Co.)



Close-up of preformed sections fitted together in mold. Next step is to pour polyester resin into bottom, close mold, and cure for 5 min. at 210° F. While this developmental container half was preformed in five pieces, production preforms will be made in one piece, cutting preforming cycle from 4.5 to 1.5 minutes

MODERN PLASTICS *31*, 99, Nov. 1953), the fibers were deposited on the screen by sucking away the water from the reverse side of the screen. This process is best adapted to making preforms of uniform thickness, and becomes expensive, requiring several preforming steps, when non-uniform sections are required.

Pressurform process

The process discussed here, developed by the Pressurform Co., makes the preform by applying the slurry to a specially designed screen *under pressure,* instead of relying on suction.

A vital part of the process is a technique for maintaining excellent uniformity of distribution of fibers in the slurry up to the moment it is applied to the screen. This uniformity, together with the high rate of deposition, makes it possible to deposit thicker, denser preforms of any desired sectional variations in one step. Any shape moldable in matched-metal molds can be pressure preformed. By selecting the pressure, density may be varied at will, and thicknesses up to two inches have been preformed.

The preforming cycle is normally shorter than the molding cycle, so one preforming machine can supply two or more presses, depending on piece requirements and curing cycle.

In other preforming processes, particularly the air-suspension processes, the quality of the preform depends heavily on the operator's skill; in the Pressurform process, which is wholly automatic, even an unskilled operator can produce uniformly good preforms. Control of composition, particularly the amount of glass, is excellent: In a preform containing 650 g. of glass, for ex-

ample, the weight of glass was kept within ±4 grams!

Aside from good uniformity of distribution of glass and organic fiber, microscopic examination of samples taken from preforms shows that the glass fibers maintain good (about 95%) "bundle integrity," an important factor from the standpoint of the mechanical properties.[1]

Preform weight can now be controlled to within ±2% and it is expected that this figure will be halved within a few months. The preforms have sufficient wet strength so that they can be loaded onto trays for oven drying. The reject rate on preforms is about one in 200, and, since no binder resin is needed, the preforms are salvageable. Because of the precision with which these preforms can be made, there is no waste "pinch-off" in the mold —the whole preform is used.

First commercial application

Specifications[2] on military containers are hard to meet, because containers must withstand rough handling, must resist corrosion and fungus attack, and must hold their seals through great changes in altitude in spite of rough handling, etc. At an altitude of 40,000 ft., where atmospheric pressure is about 3 p.s.i., a container sealed at ground level must withstand an internal pressure difference of 12 p.s.i. (about 50 lb. per linear inch of seal). Should the seal leak at high altitude, the box can't be opened at ground level unless air is bled in by hand to relieve the partial vacuum. Unless special precautions are taken, this may lead to bleeding humid, rust-promoting air into the container and its protective function will be compromised.

Previously used containers have not been entirely satisfactory but have been used even though they did not fully meet the specs. General Electric Co. recently designed a series of containers that could consistently meet all requirements. In considering materials of construction, they concluded that reinforced plastics would be better than steel and aluminum. But how about the cost? Using the pressure preforming process, these containers are being made for about 20% more than equivalent steel containers and it is expected that, with process improvements and more careful attention to design, they will shortly be able to compete with steel ones on an equal-price basis!

As originally designed, for example, there was some uncertainty as to the performance of the finished moldings and the walls were made thicker than they had to be. The original finished weight

Finished molding of container half being removed from male half of mold. Note clean edges and absence of flash

[1]The glass roving, from which the chopped glass is made, is made up of 60 strands, each containing 204 very fine filaments. If the filaments remain together in the chopped strands, if there is little shredding of strands, the bundle integrity is good. If the strands shredded completely there would be no bundles and no bundle integrity.
[2]MIL-P-116B and MIL-C-25305

Table I: Properties of pressure-preformed moldings—average values*

Property	*Glass/cotton ratio and glass fiber length, in.*						
	60/40		*80/20*		*90/10*		*100/0*
	¼	½	¼	½	¾	½	*1½- to 2½-in. fibers in glass mat*
Flexural strength,[a] 1000 p.s.i.	19.7 (16.9)	21.8 (18.5)	25.6 (17.8)	26.6 (23.4)	28.7 (24.1)	26.1 (21.5)	25.0
Flexural modulus,[a] million p.s.i.	1.24 (1.16)	1.26 (1.11)	1.54 (1.10)	1.50 (1.34)	1.66 (1.36)	1.74 (1.49)	1.2
Tensile strength,[b] 1000 p.s.i.	13.3 (11.9)	11.1 (11.8)	12.3 (12.7)	14.2 (14.3)	16.5 (16.7)	14.0 (12.2)	15.0
Tensile modulus,[b] million p.s.i.	1.29 (1.24)	1.22 (1.12)	1.11 (1.00)	1.20 (1.08)	1.58 (1.77)	1.58 (1.97)	
Compressive strength,[c] 1000 p.s.i.	14.2 (8.4)	15.3 (9.4)	20.8 (16.5)	22.6 (16.2)	21.0 (15.7)	17.0 (13.9)	
Impact strength,[d] unnotched, ft.-lb./in.	14.8	20.7	17.2	22.7	21.1	27.3	12.2
Specific gravity[e]	1.38	1.36	1.48	1.50	1.59	1.62	

*Numbers in parentheses are values after 2-hr. boil.
[a]Fed. Spec. LP406b #1031
[b]Fed. Spec. LP406b #1011
[c]Fed. Spec. LP406b #1021
[d]Owens-Corning Fiberglas L545a
[e]Fed. Spec. LP406b #5011

Table II: Individual measurements of properties of preformed moldings

Sample	*A*	*B*	*C*	*D*
Glass/cotton	80/20	80/20	90/10	90/10
Glass fiber length, in.	¼	½	¼	¼
Dry or after boil?	dry	dry	dry	after boil
Property	*Flexural strength*	*Compr. strength*	*Tensile strength*	*Tensile strength*
	1000 p.s.i.	*1000 p.s.i.*	*1000 p.s.i.*	*1000 p.s.i.*
Data on 1st molding	31.4	22.4	16.8	17.0
	26.9	24.1	20.2	18.6
	26.7	22.1		
2nd molding	27.2	19.3	15.0	15.6
	23.2	25.3	15.6	17.7
	19.2	23.0		
3rd molding	24.4	20.5	15.8	16.0
	24.9	24.3	15.5	14.9
	26.9	24.2		
Average	25.6	22.6	16.5	16.7

of 32 lb. is now being reduced to 27 lb., with consequent material savings. The over-all reject rate on these containers is less than 5%, with an expected reduction to 3% in the full-scale production process.

Properties of moldings

A continuing investigation of the dependence of mechanical properties on preforming factors has resulted in the data of Tables I, p. 163, and II, above. The specimens on which these measurements were made were cut from 10-in.-diameter disks molded in thicknesses of either 3/16 or ¼ in., each containing 55% resin by weight. Several disks of each composition were molded and at least two specimens were tested from each. Table I summarizes the results, each number appearing there being the average of six or more measurements.

Some typical individual values of test results are given in Table II to give a measure of the dispersion encountered. The testing was done in the research laboratory of the Owens-Corning Fiberglas Corp., according to Federal and O-CF methods.

The resin used in all these test specimens was Celanese MR 40R polyester resin with 2% benzoyl peroxide catalyst. It was cured 5 min. at 210° F. and 100 p.s.i. While other resins may have served as well—and some others have been found satisfactory—this one consistently wets both the glass and cotton very well. Thorough wetting is a must for 100% impregnation of these rather dense preforms in order to get top physicals and zero porosity.

Also, in the development phase it was learned that preforms must be thoroughly dried if moldings were to have optimum physicals. Since some of these measurements were made on early moldings, they can be taken as representative of the minimum performance to be expected of the process. Recent results, still coming as this article goes to press, indicate that higher and much more uniform impact strengths are to be expected.

To provide a basis for comparison, the data of the last column in Table I were gathered on specimens made by hand layup from No. 219 glass mat and the same resin (source is Celanese bulletin on MR 40R resin).

A glance at the table shows that flexural and tensile strength of preformed samples in the 80-90% glass range are about the equal of those for 100% glass, but

(*To page* 291)

After container half is molded, hardware is applied by air-operated machine that fits an aluminum gasket retainer onto the rim of the molded box. (Photo, General Electric Co.)

Finished container for airborne radar jamming unit is one-third lighter than comparable steel container, very sturdy, and resistant to corrosion and fungi. Dimensions are 16 by 16 by 20 inches

Designing better calenders

*By Kendrick J. Gooch**

The development of plastics calendering machinery is briefly reviewed. Trends toward thinner and wider film and sheeting are still continuing, along with demands for improved caliper control and surface finish control. The contour correction curves for roll crossing and the newly introduced roll bending are compared and shown to be virtually identical. The "reverse-crown" contour, designed to eliminate the "oxbow" effect that appears in most conventionally calendered sheet, is introduced. A new arrangement of the rolls of the four-roll calender, called the inclined "Z," permits the processor greater flexibility of operation and offers improved controllability in most operations. For some calendering jobs, ratios of roll surface speeds higher than those now available are needed; for the usual range of jobs, a range of "friction" ratios is needed. Individually driven rolls offer an excellent means of higher and variable friction ratios.

Primarily the process of calendering is used to densify and to produce a desired thickness and surface finish on a given material. This operation is performed between two or more pairs of rotating beams called rolls. Each roll pair constitutes a rotating die through which the material is either drawn or extruded, or both. No exact mathematical analysis of the flow/pressure situation in the hot, non-Newtonian plastics as they pass through the rolls has yet been published. However, considering that the material appears at times to be rather soupy, amazingly large forces are required to keep the rolls together. (See Ref. 1)[1].

The designer of a calender is primarily concerned with the following items:

1) Material or materials to be processed; 2) the maximum finished width of these materials; 3) the range of film (or sheet) thicknesses desired; 4) the maximum rate of production required; 5) if the compound is a new one, what separating forces are expected; 6) the range of operating roll temperatures required; and 7) the power requirements.

Other factors for improvement of the calender from the operator's viewpoint can come under consideration as the design progresses, but, for selection of the correct type and size of machine, the seven points listed must first be settled.

The ultimate aim in calender design is to create a machine which combines the following characteristics:

1) Maximum rigidity of roll positioning to maintain maximum accuracy; 2) greatest flexibility in range of materials and film and sheet thicknesses which can be produced; 3) an allowance for handling the materials of the future which, based on past experience, will require more power and even greater roll stiffness; and 4) the accomplishment of the above at a price that is reasonable enough to be acceptable to the customer.

Nature of compound indicates type of calender

Many of today's producers of plastics films obtained their start with rubber calenders. It was soon realized that plastics calendering presented problems that these calenders could not handle. Higher operating temperatures were required, so bearing clearances were made larger and flood lubrication was added. As the industry developed and greater accuracy was required, other design improvements were gradually made. These included preloading, roll crossing, and the Z roll arrangement introduced by Farrel-Birmingham.

Then the very rigid compounds appeared, bringing with them new design problems. Some of these compounds may be better handled with only two passes on a three-roll calender. Some require roll operating temperatures as high as 500° F., and the best friction ratios[2] for calendering these compounds have not as yet been determined. Normally, allowance for an increase in power requirements is made by selecting a d.-c. motor that develops full horsepower at a base speed about 30% below the rated maximum speed. However, recent information indicates that the new rigid materials will require full power at speeds that are 50% below maximum.

From the foregoing, it is seen that the nature of the materials to be processed profoundly influence the following design factors:

1) The range of separating

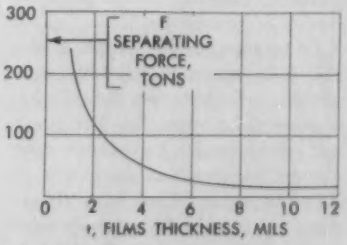


Fig. 1: Measured separating forces on a 28- by 66-in. calender roll. This hyperbola-like curve is well fitted by the empirical equation $F=238\ t^{-1.18}$

*Assistant Division Engineer, Mill & Calendering Engineering Div., Farrel-Birmingham Co., Ansonia, Conn.

[1]References were prepared by the editor.

[2]Friction ratio is really a speed ratio. The rolls of a calender are generally run at different speeds, with speeds increasing in the direction of sheet travel. Friction ratio is the ratio of the surface speed of a given roll to that of the roll just preceding it in the train.

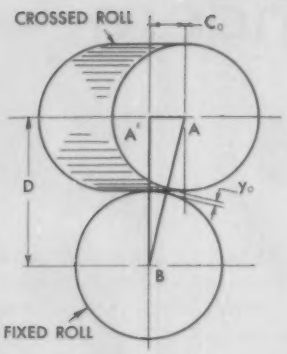


Fig. 2: Greatly exaggerated end-view diagram of roll crossing in which the distance AA'=C_o is the amount of crossing at the end of the roll face and y_o is the initial (x=0) aperture between rolls

forces per inch of face that can be expected; 2) the number of rolls required; 3) friction ratios or range of friction ratios required; 4) maximum roll temperature and range of roll temperatures required; and 5) power required in proportion to size.

Wider sheet, sturdier machine

Equally important to the calender designer is the maximum width of sheeting to be made. Greater and greater widths have been demanded. Through improvements in compounding, roll design, and temperature control, the available width of calendered film and sheeting rapidly increased from an old maximum of 48 in. up to 72 in. and wider; 108-in.-face calenders have been seriously considered and the maximum width of calendars will probably increase with the demands of the market.[5]

Of course, as the length of the roll face increases, the total separating force between the rolls increases proportionally. For present compounds, roll faces over 100 in. require roll diameters of 40 to 48 inches. Such large diameters are required to provide adequate roll strength and stiffness, and sufficient bearing areas. However, since the size, and therefore the cost, of a calender increases rapidly with roll diameter, it is clear that to calender wider sheeting requires a bigger investment.

[5]Ed. note: Polyethylene film is already being made in widths up to 30 ft. by extrusion.

Thinner sheet, bigger forces

The separating forces on calender rolls vary approximately inversely with the sheet thickness for a given compound. (See Fig. 1, p. 165). Three factors—type of compound, width of sheet, and minimum sheet thickness—usually determine the size of a calender. However, the *range* of sheet thicknesses to be produced is also an extremely important design factor.

Few plastics calenders are designed today to make a single size of sheeting from a single stock. Usually the maximum flexibility is desired, so that thin films and heavy sheeting can be produced to satisfy market requirements.

This in turn means the rolls will be subjected to a wide range of separating forces. These forces bend the rolls, changing the shape of the aperture between them. If some compensation for this bending were not made, the sheet thickness would vary considerably over its width. To keep the sheet flat, two techniques of compensation are used. In one—roll bending[4]—an opposing bending moment is applied to the rolls. In the other—roll crossing—one roll axis is crossed slightly with respect to the other by causing it to pivot about its midpoint of length. A great deal has already been said about these two methods of crown compensation. Nevertheless this subject is very important to calender design and it is interesting to compare the theoretical crown contour corrections produced by roll crossing and by bending.

[4]Roll bending is a patented technique; it is described in Reference 2.

Roll crossing contour

Figure 2, is a diagrammatic representation of two crossed rolls, assumed to be cylindrical and to be tangent at their lengthwise midpoints. (Under actual calendering conditions, of course, there is usually some clearance between the rolls, but this clearance is irrelevant to the present discussion and is allowed to be zero for simplicity's sake.) The angle of crossing, in practice on the order of 1°, is here greatly exaggerated, and the two end faces are nearly, though not quite, coplanar. Thus triangle $AA'B$ can be taken to be a right triangle, where A' would be the position of A if the rolls were not crossed. The distance $A'B$ equals two radii or one roll diameter, D, and AA', the crossing at the end face, is called C_o. The minimum clearance between the two end faces,

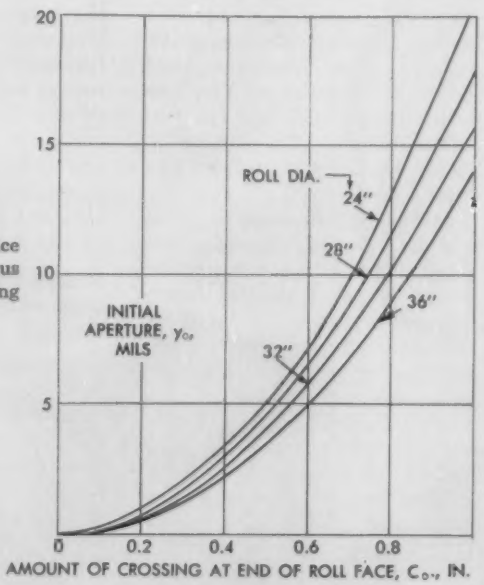
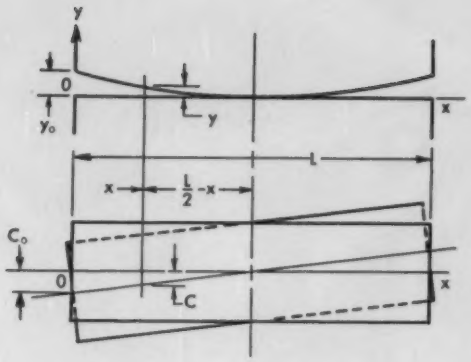
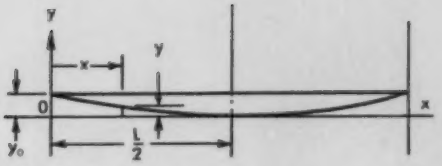


Fig. 3: End-face clearance between rolls of various diameters with increasing amounts of crossing





Figs. 4 and 5: Figure 4, at left, shows the coordinate system and geometric relationships used in calculating for roll crossing the aperture y at any distance x from the end of the roll. The diagram in Fig. 5, above, gives a corresponding picture for roll bending.

which would presumably be the same over the whole length of the roll under the operating bending load, is the end clearance, y_0. Under *no* load, however, the clearance varies from this value to zero at the point of tangency in the center and then back up to y_0 at the opposite ends of the rolls. By the Pythagorean theorem,

$$y_0 = \sqrt{C_0^2 + D^2} - D \qquad \text{Eq. 1}$$

where all quantities are in inches.

The quantity y_0 has been calculated for a number of typical roll diameters and for different amounts of crossing at the end face as shown in Fig. 3, p. 166.

If the end-face crossing C_0 and the roll dimensions are known, it is possible to compute the clearance y between the rolls at any point x measured from the end of the roll toward the middle. Figure 4, above, shows two sketches of the crossed rolls, the lower being a top view (of vertically positioned rolls), and the upper being a view of what the clearance between the rolls would look like if all were seen in the same plane.

By similar triangles, the amount of crossing at point x is given by

$$C = C_0\left[\frac{L/2 - x}{L/2}\right] = C_0\left(1 - \frac{2x}{L}\right) \qquad \text{Eq. 2}$$

Referring again to Fig. 2, the clearance y is calculated from Eq. 1 by substituting C for C_0 in that equation. That is,

$$y = \sqrt{C^2 + D^2} - D \qquad \text{Eq. 3}$$

and

$$y = \sqrt{C_0^2\left(1 - \frac{2x}{L}\right)^2 + D^2} - D \qquad \text{Eq. 4}$$

If D in Eq. 3 is transposed to the left side and both sides are squared, and if the y^2 term, which is minute in comparison to the $2yD$ term, is dropped, the remaining equation can be simply solved for y to give

$$y \cong \frac{C^2}{2D} \qquad \text{Eq. 5}$$

Similarly,

$$y_0 \cong \frac{C_0^2}{2D} \qquad \text{Eq. 6}$$

Substituting Eqs. 2 and 6 into Eq. 5,

$$y \cong y_0\left(1 - \frac{2x}{L}\right)^2 \qquad \text{Eq. 7}$$

A curve of y vs. x is called the contour correction curve of roll crossing.

Roll bending equation

The theoretical roll-bending contour (again, when there is no working load) is that produced by two couples acting on a uniform beam (Fig. 5, above). Because of the symmetry of the situation, these couples would normally be equal in magnitude and opposite in sign, i.e., both would tend to bend the beam either opposite to the working load, or, occasionally, in the same direction. This problem is considered in Reference 3. Taking into account the differences between the coordinate axes used there and here, we get

$$y_0 = \frac{ML^2}{8EI_r} \qquad \text{Eq. 8}$$

$$y = y_0 - \frac{M}{2EI_r}(Lx - x^2) \qquad \text{Eq. 9}$$

then

$$y = y_0\left[1 - \frac{4(Lx - x^2)}{L^2}\right] = y_0\left(1 - \frac{2x}{L}\right)^2 \qquad \text{Eq. 10}$$

This is the contour correction curve for roll bending; perhaps surprisingly, it is identical with Equation 7. Thus if small, second-order errors in the roll-crossing curve are neglected, the two contour correction curves are the same. The two curves were calculated by the *exact* formulas (Eqs. 4 and 10) for a 24- by 66-in. cylindrical roll pair having an end face aperture, y_0, by either crossing or bending, of 0.004 inch. The biggest difference in y values is less than a millionth of an inch, much too small to show in the plotted curve (Fig. 6). Thus roll bending and roll crossing appear to provide very similar crown correction curves, so similar that they are identical within practical tolerances for grinding crown. Because the deflections involved are small, both these curves follow closely the curves for the deflection of the roll under the uniformly distributed working loads, although those are 4th degree equations.

However, in actual practice, we do not have a theoretical roll. Even with drilled rolls and a circulating fluid temperature-control system, the rolls are a few degrees cooler on the ends when producing stock. Also, a roll is not uniform in cross section, nor is it exactly uniformly loaded. This combination has resulted in the so-called "oxbow" sheet contour which is observed on all cal-

(*To page* 170)

being made in widths up to 30 ft. by extrusion.

AMOUNT OF CROSSING AT END OF ROLL FACE, C_o, IN.

Stokes Model 741 presses at Bulldog Electric Products Co., Urbana, Ohio are so fully automatic, so fool-proof that they run virtually unattended . . . need only about one-tenth of a man's time per machine.

"Bulldog Electric" plastic parts molded to high manufacturing standards on Stokes Model 741 presses...

Fully automatic compression molding, on Stokes Model 741 presses, produces close-tolerance electrical distribution equipment parts around the clock at Bulldog Electric Products Co.'s Urbana, Ohio plant.

When molding "goes fully automatic" with Stokes presses, quality is high and costs are low. That's the experience of many custom molders and plant molding departments. Bulldog Electric Products Co., for instance, has a battery of Stokes Model 741 50-ton presses that turn out plastic parts for electrical fixtures. Used with both general and special purpose phenolics, melamine and urea formaldehyde compounds, these presses run 24 hours a day. They give high precision and uniform quality that easily meet requirements of Bulldog's Standards Department — plus volume and economy that the production group must have in this competitive industry.

In spite of constant operation, Bulldog's superintendent reports "maintenance has been nominal, and overall performance of each machine has equalled or excelled the manufacturer's predictions."

J. A. Kempf, superintendent of Bulldog's Plastic Division, examines parts molded in Stokes Model 741 presses.

For your own molding operations, it will pay you to check the advanced features of the new Stokes 741 that bring you fully automatic compression molding in its most fool-proof, most productive form. Built into these presses are refinements that we have developed during our 25 years of leadership in automatic molding:

Parts can't fall back into molds . . . due to metal-to-metal contact between feed and comb, and scrape-off discharge independent of gravity.

Simplified set-up . . . feed changeovers made in five minutes. Pre-set loading board provides custom-adjusted feed for each job as part of the tooling.

Fast cycle, high output . . . average dry cycle time only 8 seconds.

Space-saving . . . in-line press design cuts floor area requirements, lets you line up feed and discharge in convenient rows.

Tops in versatility . . . top or bottom ejection available to suit the job . . . readily adaptable to side-draw split cavity molds, to direct feed from pre-heater, or, with Stokes rope feeder, to automatic feed of rope pre-mix.

Press capacities of 50, 75, 125 and 200 tons are available. Write today for a copy of our new bulletin on the Model 741, for a consultation on your requirements, and for a cost study on your specific application.

Plastics Molding Equipment Division
F. J. STOKES CORPORATION
5540 Tabor Road, Philadelphia 20, Pa.

STOKES

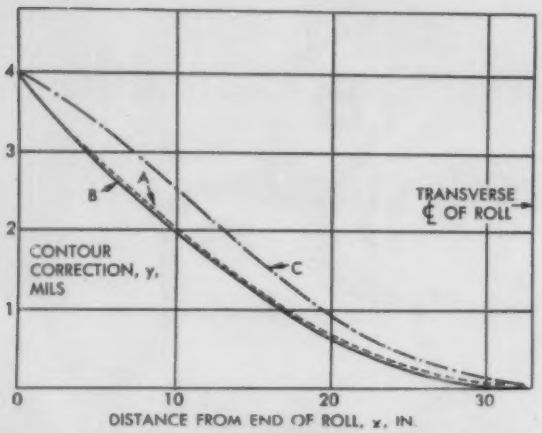


Fig. 6: Contour correction curves give the aperture y between roll pairs, in terms of distance from end of roll x for roll crossing or roll bending, *A*. *B* represents actual bending curve of a cylindrical, uncrossed roll under the processing load; curve has been inverted to show closeness with which correction techniques compensate for processing load. *C* is aperture which would be observed with a "reverse-crown" roll under operating load. Additional correction of "reverse crown" makes sheet heavier where "oxbow" effects normally make it thinner and *vice versa*

enders, including those in the rubber and flooring field, both with and without roll crown compensation.

To compensate for these practical factors that cause oxbow, the so-called "reverse 'crown" roll contour has been developed[5]. This is obtained by grinding the crown so that its shape differs from the theoretical one determined by the expected bending under the uniformly distributed working load by what might be called a "reverse oxbow." That is, the crown is made lower at points where the sheet is normally thin, and higher at points where it is normally thick.

The amount of "reverse crown" varies with the size of roll and its application, but if it is adjusted for the thinnest film that is expected to be produced, it eliminates the oxbow well over the entire thickness range. The approximate contour which the 24-by 66-in. roll under discussion should have for actual operating conditions is curve C in Fig. 6, left.

[5]The reverse crown contour is a patented technique.

Variation is important

Besides the shape or contour produced by crown-compensation devices, the amount of variation in crown that can be obtained is also important. The range of crown correction obtained by roll bending is limited by the maximum allowable bearing loads and roll-neck bending stresses imposed by both the bending and separating forces. By designing the roll bending mechanism so that roll deflection can be increased as well as decreased, the range is widened. However, the roll support shifts from the main

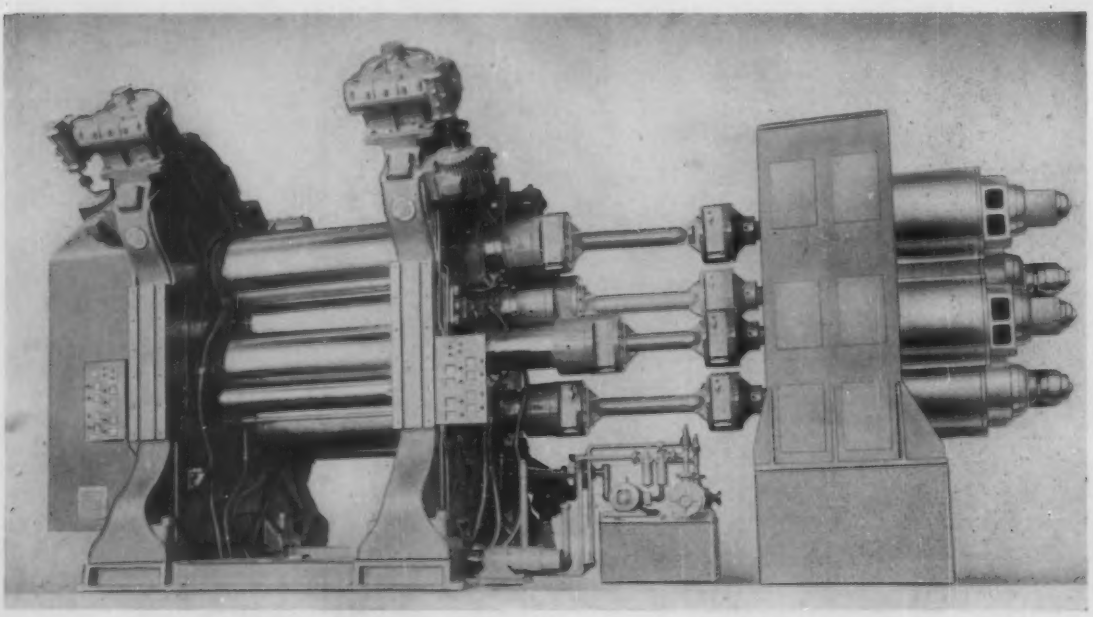


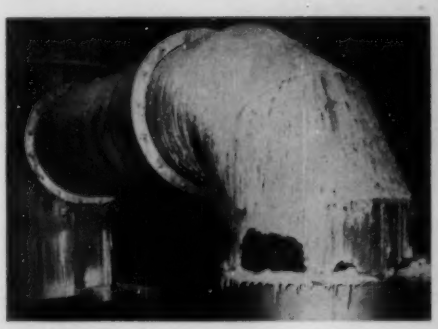
Fig. 7: Front view of inclined "Z" calender with individually driven rolls and roll crossing. (Photo, Farrel)

CYANAMID

PLASTICS NEWSFRONT

THREE YEARS IN CORROSIVE SERVICE WITHOUT MAINTENANCE

That's the record established by reinforced LAMINAC® polyester resin in venting service on alum digesters at Cyanamid's Warners plant. The carbon steel breech (left) in an alum evaporator required frequent maintenance, failed after less than three year's service. Glass-reinforced LAMINAC stacks (right) in even more severe alum digester service, have needed no maintenance in more than three years. The LAMINAC units cost less in the long run, and were easier to erect and assemble, using either telescope joints wrapped and polyester-welded on the site, or flange-type joints.



ATTRACTIVE, AIRTIGHT CASE FOR STICK COLOGNE

Six new scents of Avon Stick Cologne are packaged in smartly styled, practical cases molded of BEETLE® urea molding compound. Cases have a white base with contrasting closures in a different color for each scent. Airtight, the BEETLE case stops evaporation of the cologne. Yet the closure opens easily, and with a twist of the wrist the stick pops up for use. The case resists alcohol, essential oils and chemicals as well as staining from perspiration and grime, which wipe off easily.

FUNCTIONAL HANDLES GRACE CARAFES

Any dining or buffet table would be graced by this attractive carafe with its stylish, beige-colored handle molded of CYMEL* melamine molding compound. Elegance and function are combined in the handle, balanced for easy, comfortable pouring. Harmonizing with the carafe's gold decoration, the molded-in color won't chip or wear off. In keeping with its function, CYMEL is exceptionally strong, resistant to heat and flame, and stays cool even when the carafe, made by Club Aluminum Products Company, is full of hot coffee.

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MATERIALS FOR TOMORROW

Fig. 7: Front view of inclined "Z" calender with individually driven rolls and roll crossing. (Photo, Farrel)

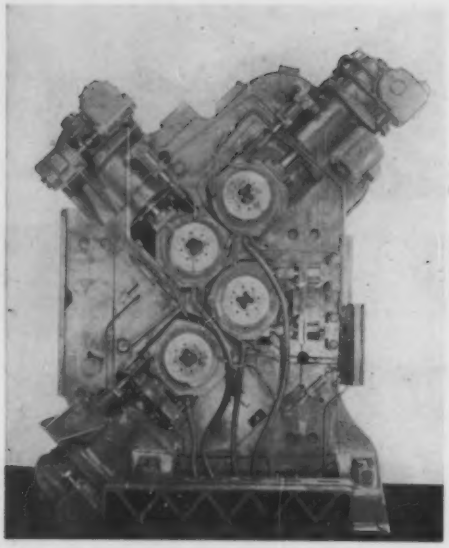

Fig. 8: End view of inclined "Z" calender with guard removed

journal bearings to the bending mechanism the instant unbending is utilized.

The range of roll crossing is limited only by the stresses resulting from the separating force. However, roll crossing will provide greater contour compensation than roll bending, even when both rolls of a pair are bent. If the full capabilities of roll crossing are to be realized, it must be applied to a pair of rolls which are free to deflect, e.g., the top and offset rolls of an inverted-L calender or any roll pair of a Z calender.

The roll-crossing method requires that the calender be driven by a unit drive. This type of drive involves a higher initial investment than the common design using gearing mounted on the rolls, plus a separate reduction unit.

However, the unit drive offers these additional advantages: it requires less maintenance; it eliminates the unbalanced separating forces developed in gears mounted directly on the rolls, thus making caliper control easier; much more reliable lubrication of the gears can be provided, and, not being attached to the rolls, the gears operate at lower temperatures; finally, it is much easier to remove the rolls for regular regrinding, with consequent saving in down-time. For these reasons the unit drive has been widely accepted in the industry on its own merits. Not counting the cost of the unit drive, roll crossing equipment costs about as much as is required for roll bending equipment.

Inclined "Z"

Once the design specifications which determine the size of the calender have been settled, other features, such as the general arrangement of the calender for ease in threading, accessibility of the rolls, and general convenience of the operator should be determined. The "Z" calender has now been in use by the plastics industry since 1946, and this roll arrangement has become an accepted standard along with the well known inverted-"L" arrangement.

Recently, a new kind of calender design called the inclined "Z" has been developed at Farrel-Birmingham. Figure 7, p. 170, illustrates this machine and Fig. 8 is an end view of it, from rotary joint end. Note that the basic "Z" roll arrangement, which permits free roll deflections, has been maintained. However, this inclined position provides a clear and short path for material travel, and the embosser or other attachments can be placed close to the pick-off roll.

Material is now taken off the #3 roll, (3rd down), which is more accessible than on any previous design. Taking the material from the #3 roll is believed to be beneficial, since the side of the sheet next to this roll is uppermost for subsequent embosser or polishing rolls in the calender train. This side of the sheet normally has the better finish because it is constantly in contact with the #3 roll, and is, therefore, less disturbed by the rolling bank between the #3 and #4 rolls.

The arrangement also permits the calender to be conveniently used as a three-roll unit without reversing the calender train. This is a desirable feature, since, as mentioned previously, some of the newer rigid materials are reported to calender better with only two roll passes. Also, the same direction of travel can be used for sheeting and for coating or laminating. Farrel-Birmingham is building four inclined-"Z" calenders, two for use with plastics materials and two for rubber.

Variable roll friction

The early calenders designed specifically for plastics had even, or 1:1, friction ratios on all passes. These roll frictions were later modified to 1.15:1 on the first pass, 1.03:1 on the second pass, and 1.03:1 or 1:1 for the last pass.

The operation of present calenders has been restricted by these friction ratios and nearly all compounds have been formulated so that they suit these fixed roll frictions.

To overcome this fixed friction problem, calenders should be built with a separate motor drive for each roll. This drive arrangement permits a wide range of roll friction ratios which can be preset and controlled electronically in a manner which is somewhat similar to the present sections of a calender train.

One important advantage of multiple drives is the ability to increase stock temperatures by developing molecular friction through the use of higher-than-normal roll friction ratios.

There are two designs for this drive at present. The first employs large gear motors connected

(*To page* 293)

Volume and pressure effects in compression molding–Part I

By W. R. McGlone and L. B. Keller**

This paper (in two parts) discusses the events which take place during molding in a compression mold. Pressure and volume changes occurring within a mold cavity have been measured with respect to cure time, in order to obtain an insight into the nature both of the molding process and of the thermosetting materials being investigated.

At present, compression molding has the status of a technical art. Despite the fact that this technique of converting plastics raw materials into shapes is one of the oldest and most widely used in the industry, very little organized scientific effort has been expended upon it. Far more attention has been paid to the study of other forming techniques, such as injection molding, extrusion, and transfer molding.

Experienced compression molders have learned to meet most requirements by the method of trial and error; they have built up a store of technical lore suitable for most exigencies. However, the precision required in the new field of missile and airborne radar systems has demonstrated that experience alone is often insufficient and that a more basic understanding of effects is necessary.

*Member of the technical staff, Hughes Research and Development Laboratories, Culver City, Calif.

Organization of the study

The conversion of thermosetting molding compounds into cured shapes is accomplished by the application of heat and pressure on the material while it is confined in a rigid metal mold. During conversion, the resinous material in the molding compound changes physically from a powdery or granular form to a semiliquid and, finally, to a dense solid. Chemically, it changes from a polymer of low molecular weight to a highly cross-linked material of high molecular weight. We have, therefore, complex physical and chemical phenomena occurring simultaneously as a result of externally applied pressure and heat.

There are few references in the literature to the measurement of pressure on a plastics part during molding. Gilmore and Spencer(1)[1] performed extensive work on the roles of pressure, temperature, and time in the injection molding process. Rausch and Orvis(2) have reported the study of pressure distribution in transfer molding of thermosets; however, no references to the study of pressure relationships in the compression molding of thermosets have been found.

In order to study molding by compression, it was decided first to outline the events expected to occur in a positive, *unlanded* compression mold, and then to demonstrate these events experimentally in a limited series of

[1]Numbers in parentheses link to references at the end of article, p. 294.

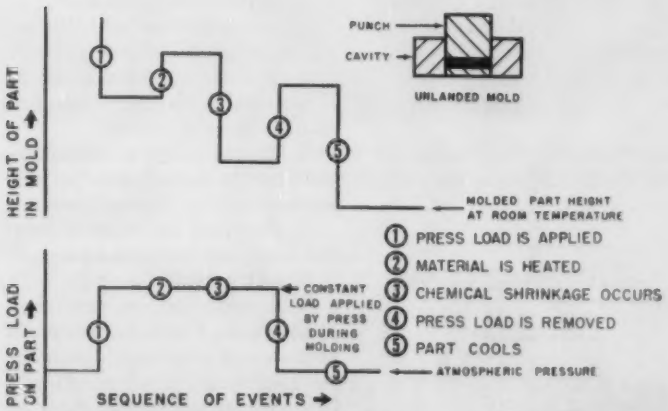

Fig. 1: Pressure and volume relationships in an unlanded compression mold

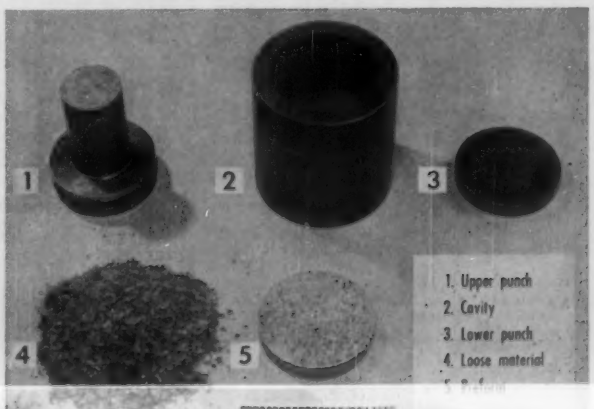

Fig. 2: Simple unlanded compression mold used in preliminary tests

tests. An unlanded mold was chosen for initial study because in this type of mold full press pressure is transmitted to the part, and because volume changes of the molded part which result from the events outlined are easily measured during molding. Despite the fact that the unlanded positive mold is seldom used in industry, it does represent the simplest form of compression molding and it was expected that the information gained could be applied to the more commonly used landed mold.

A more extensive study was undertaken of the sequence of events occurring in a positive *landed* compression mold by means of changes in pressure on the molded part. In the case of both the landed and unlanded mold, the shape molded was a simple disk. Unlanded molding is discussed here in Part I, while landed molding results will be presented in a subsequent issue.

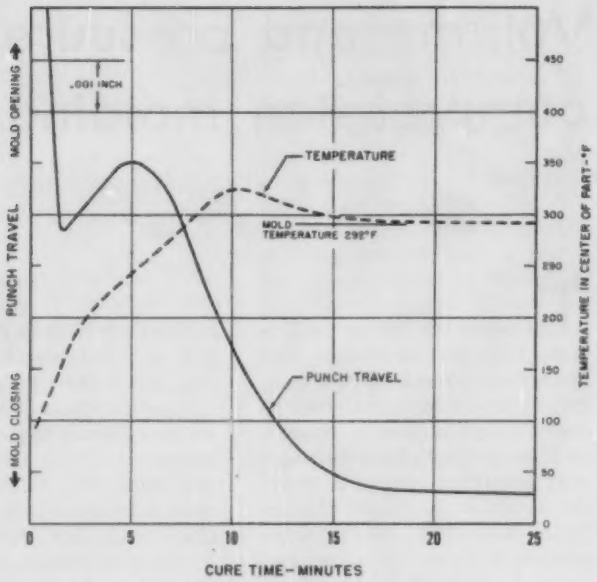

Fig. 3: Punch travel and center temperature of specimen during compression molding

Postulated pressure-volume relationships

Figure 1, p. 173, shows a schematic drawing of an unlanded mold and two diagrams of the sequence of events as they were believed to take place. In the upper diagram, the vertical axis is the volume of the part as represented by its height or thickness. The height may be so used since the lateral dimensions of the part are restricted by the rigid cavity during molding and all major volumetric changes appear as changes in thickness. In most steel molds at commonly used molding pressures, lateral deflections of the mold are minor. The lower diagram shows the press load on the part versus the sequence of events. The press load is equal to the load on the mold by the press, if friction is negligible. These diagrams are intended to illustrate the direction of the various effects that occur during molding. It is assumed that the press load is constant during molding.

Now, following the sequence of events in the diagrams, the mold is charged with molding material and then:

1) The press load is applied with an accompanying compression of the plastic, as shown by a reduction in part height.

2) The material expands due to heating by the mold; press load remains constant since it has a constant-pressure system.

3) Polymerization and the resulting chemical shrinkage take place and the part height shows a decrease, with the press load still at the same value.

4) The press load is removed as the mold is opened, and the part springs back or decompresses.

5) The part is removed from the mold and contracts as it cools to room temperature.

It is important to note that, although the events are shown in sequence to demonstrate their direction, some of them actually occur concurrently. For example, some of the material compression, some of the expansion, and the first of the chemical shrinkage, may be taking place simultaneously. After release of pressure, the part may not completely decompress immediately (as a purely elastic material would) so that the decompression may occur during the cooling, perhaps accompanied by some residual

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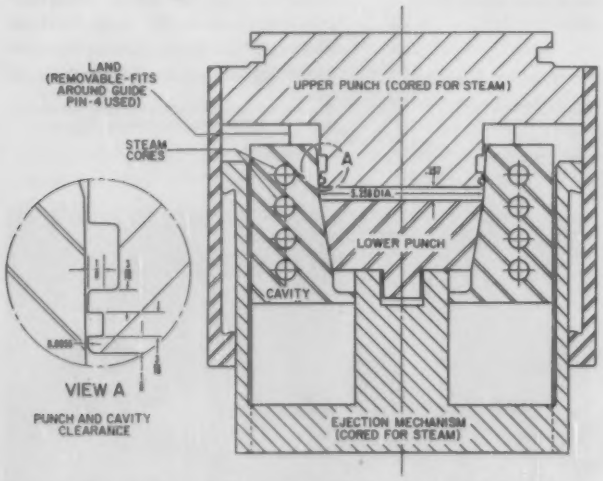
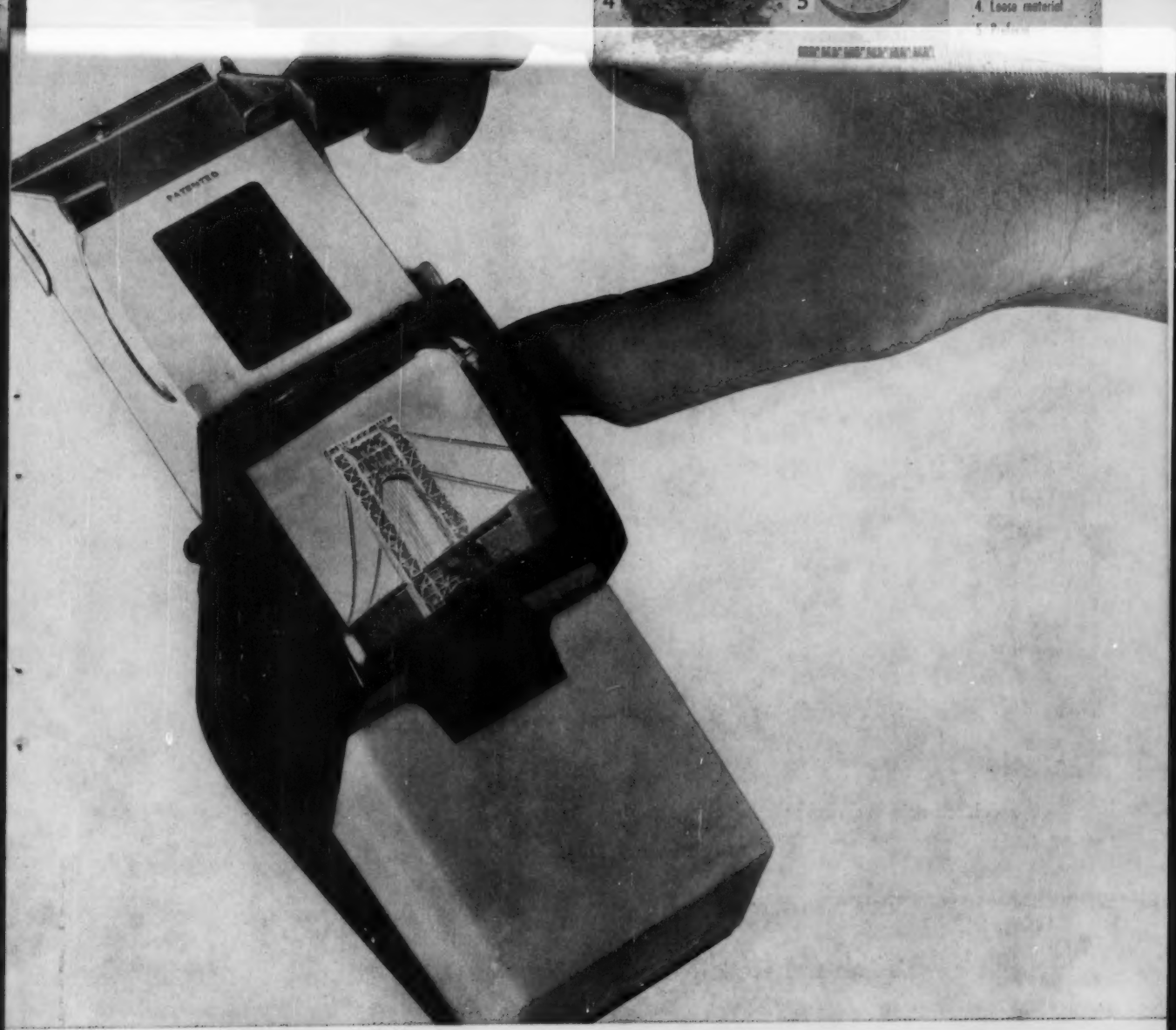


Fig. 4: Details of mold used in punch travel test



Molded from BAKELITE High-Impact Styrene, viewer for 35-mm. slides is part of a set that includes a slide file case. Both are described on the next page.

At one plastic source, you

Select from the greatest variety

PHENOLICS
STYRENES
IMPACT STYRENES
POLYETHYLENES
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(continued on next page)

Select from the greatest variety

(continued from page one)

"Lazy Shutterbug" slide file case and viewer made by J. & M. Zadiix Products Co., Brooklyn 15, N. Y.

High impact styrene for beauy and durability

This revolving file case for 35 mm. color slides and its companion viewer (previous page) will take a lot of handling. To select slides from the case, the colored strip is dialed to the proper square. When the strip is lifted, a magazine of slides rises.

To stand up under constant operation and usage, the case and viewer are molded of BAKELITE Brand High-Impact Styrene TMD-5151. The smooth functioning of the component pieces testifies to the molding precision and dimensional stability of this material. Working parts are intricately formed with guides, pins, and brackets. Despite the complex design, finish is smooth, details sharp. In production, TMD-5151 demonstrates inherently high plasticity, providing the fastest set-up speed available in a high-impact styrene.

Oils can't harm cover and motor housing of new honing and sharpening stone

The manufacturer of this machine describes it as "the first power hone for hobby workshops and kitchen." Notice the way BAKELITE Brand Styrene Plastic has been used in its design and construction. Both the cover for the stone and the housing for its electric motor are molded of BAKELITE Styrene compound, SMD-3500.

Prime reason for using this material was the resistance of SMD-3500 to water and oils used in sharpening. This property safeguards the other obvious advantages—the gleaming finish, rich color, and fine molded details.

SMD-3500 is a free-flowing general-purpose polystyrene compound that combines excellent moldability and fast setup. It is widely used in injection molding operations because of its superior ease of molding. A wide range of colors, as well as a crystal clear formulation, is available.

"Lectro-Hone" sharpener, manufactured by E. F. Britten Inc., Cranford, N. J. with cover and housing molded by Applied Plastic Co., Garwood, N. J.

EPOXIES

advantages result in the quality products shown on the following pages.

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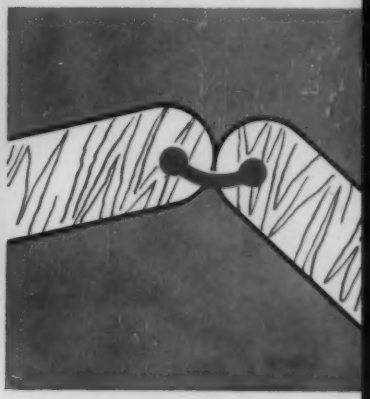
"Space Saver Dor" made by Wood Specialty Products Inc., with hinges extruded by Davidson Products Company, Seattle, Wash.



Strong, silent hinges for folding doors are extruded from BAKELITE Vinyl Plastic

The full length, one-piece hinges that connect the panels of these folding doors have withstood 250,000 opening and closing cycles, the manufacturer reports. They operate quietly, without squeaks and with friction-free smoothness. They are extruded from BAKELITE Brand Vinyl Elastomeric Plastic.

This toughness offers another benefit. When the doors are being assembled, the hinge strips are inserted by being drawn through undercut grooves along the edges of the wood panels. The vinyl strips don't tear during this operation. They are formed with an H-shape that fits snugly into the grooves. The flexing area also has the precise thickness needed to function properly.

Another feature of this BAKELITE Elastomeric Vinyl is its resistance to household cleaning materials, waxes, paints, varnishes, and lacquers. Since vinyls are readily colored, the hinges may be made to harmonize with the woods used in the panels.

See BAKELITE Company exhibit
Pacific Coast Plastics Exposition, Shrine Exposition Hall, Los Angeles, March 18-21, Booth Nos. 308, 310, 314

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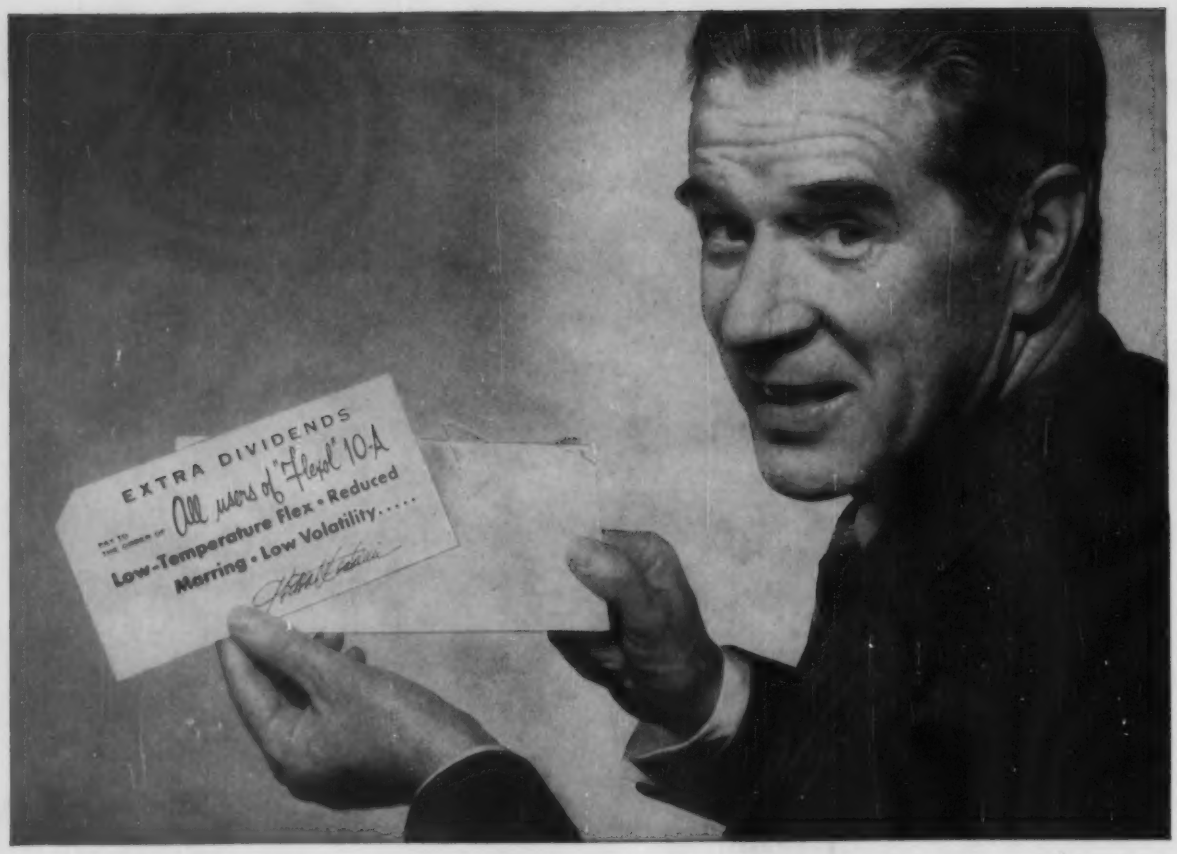

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FLEXOL Plasticizer 10-A is widely useful in the vinyl plastics industry in calendered film and sheeting, electrical insulatjon compounds, profile extrusions, slush moldings, and dip coatings. It is a good plasticizer for nitrocellulose and a softener for natural or synthetic rubber.

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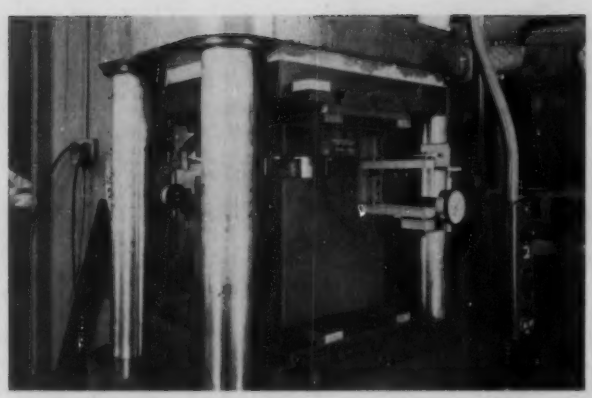

Fig. 5: Set-up for punch travel tests showing both front and rear indicators

chemical shrinkage. Note that in this unlanded mold with the constant-pressure system, the punch is free to follow volumetric changes which take place against the molding pressure.

Preliminary experimental verification

In order to investigate the behavior of material in an unlanded mold, a simple experiment was carried out in which an indicator was mounted so that the travel of the punch would be measured during molding. An unlanded, fully positive mold (Fig. 2, p. 173) with a 4½-in.-diameter cavity was employed in this test. Two preforms of 75 g. each (approximately ⅜ in. thick) of Diall 50-01[2] were made in the cold mold. Small channels were filed into the mold so that a thermocouple could be introduced into the cavity with no danger of being sheared off during molding.

The press used was a 20-ton unit. The load was applied by a hand-operated hydraulic jack.

In the experiment, the two preforms were loaded into the hot (292° F.) mold and the thermocouple was sandwiched between them in the center of the cavity. The mold was placed in the press, and the molding pressure on the part was rapidly raised to 2500 p.s.i. From the time the mold was loaded, the position of the punch and the temperature inside the molded part were recorded every 15 sec. for 25 minutes. The final molded part thickness was 0.440 inch.

A graph of these data is given in Fig. 3, p. 174. The solid line shows the movement of the punch in 0.001 in. during molding near the bottom of its travel. As the pressure was applied, the punch travelled down for about 1½ min. of cure time; then it began to move upward. At about 5 min. it again reversed and started downward, leveling off at about 15 minutes. This curve represents an initial decrease in part height, then an increase in thickness and finally another decrease. Notice particularly the general correspondence between this curve and *1*, *2*, and *3* of Fig. 1. The study of the decompression *4* and the cooling *5* was undertaken later and is not reported here.

The temperature curve in Fig. 3 (dotted line) rises slowly to a level higher than that of the actual mold temperature, because of the exothermic heat of reaction of the molding material. The in-the-mold shrinkage of the part (second downward travel of the punch) can be seen to be well under way before the temperature has reached a maximum; this may be due to the fact that the temperature was measured in the center of the molded part and the heat gradient from the edge of the part to the center was quite large, so that the chemical reaction was probably much further advanced in the outer areas, and a considerable chemical shrinkage had occurred there before the center reached peak temperature. This non-uniform curing should cause a residual compressive stress near the surfaces of the part and a tensile stress internally after curing. The work reported in Reference 3, in which the residual stresses were actually meas-

Table I: Materials investigated

Material designation	*Material type*	*Material manufacturer*
Diall 50-01	Orlon fiber-filled diallyl phthalate	Mesa Plastics, Los Angeles, Calif.
51-01	Asbestos-filled diallyl phthalate	
52-01	Short glass fiber-filled diallyl phthalate	
50-51	Dacron fiber-filled diallyl phthalate	
Durez 14482	Two-step, fabric-filled phenolic	Durez Plastics Div., Hooker Electrochemical Co., North Tonawanda, N. Y.
16274	Two-step, mineral-filled phenolic	
1900	One-step, flock-filled phenolic	
1905	One-step, flock-and-fabric-filled phenolic	
16221	One-step, long glass fiber-filled phenolic	
Bakelite BM-120	Two-step, wood flour-filled phenolic	Bakelite Co., New York, N. Y.
Alkyd 446	Long glass fiber-filled alkyd	Barrett Div. Allied Chemical and Dye Corp. New York, N. Y.

[2]Material types and names of material manufacturers are given in Table I, at right.

even for the big ones it's

ured by an ingenious technique, shows that this stress situation is typical of thermoset moldings.

Since the press load was exerted by a closed system, a small pressure variation occurred as the punch moved. That this variation did not materially affect the shape of the punch-travel curve is shown by later tests employing a constant-pressure system (see Fig. 6, below).

Additional studies—punch travel method

A semi-automatic compression mold was set up so that punch-travel curves similar to that in Fig. 3 could be obtained for various materials and under varied molding conditions, since curves of this type should be of value in showing characteristics of a material during molding. The mold, which is shown diagrammatically in Fig. 4, p. 174, was set up for these tests with two indicators as shown in Fig. 5, p. 179.

The indicators were adjusted to read the same value with the mold closed to the lands under pressure. The lands were removed, the mold was charged and closed rapidly, and both indicators were read throughout the molding cycle. All curves were plotted from average values of the two indicators as a correction for the tilting of the upper press platen. The same scales were used in plotting each of the curves.

Punch-travel curves—Diall 50-01: Figure 6 shows the relative shape of punch-travel curves for Diall 50-01 when molded at 50 tons press load (5000 p.s.i. upon the area of the part) with arbitrarily chosen charge weights of 90, 175, and 280 grams. The graphs show that the difference in height between Points *A* and *B* increases with increasing charge weight. Point *A* is the highest point reached by the punch after closure of the mold, and *B* is the point at which the curve becomes essentially level. This difference will be termed the "apparent chemical shrinkage." It is not equal to the true chemical shrinkage since the material has a greater compressibility at *A* when it is virtually liquid than it has at *B* when it is a solid; also, some chemical shrinkage has undoubtedly taken place at the sur-

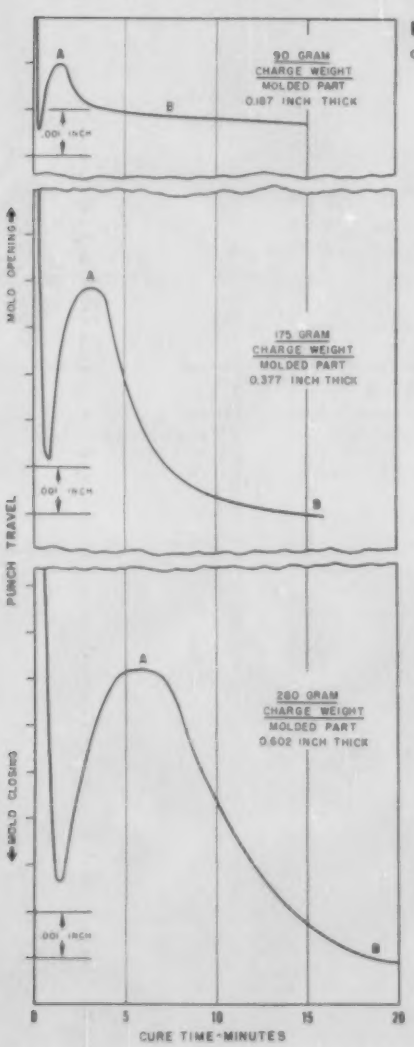

Fig. 6: Effect of charge weight on punch travel of Diall 50-01

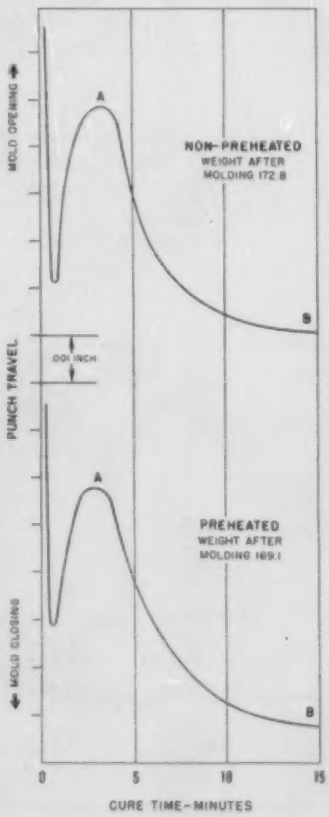

Fig. 7: Effect of preheating on punch travel of Diall 50-01

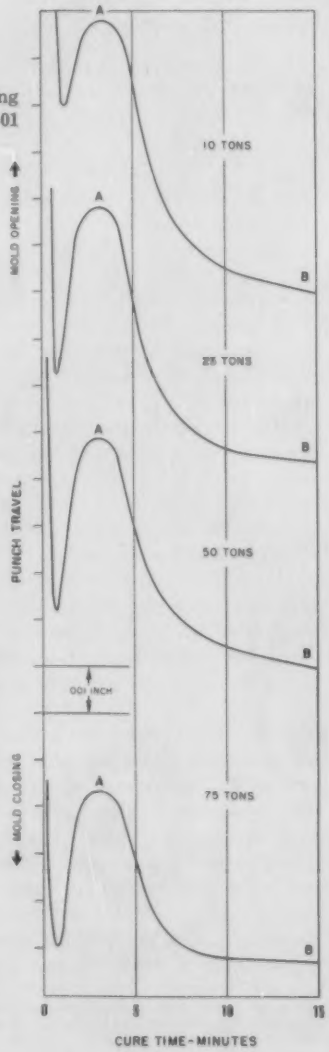

Fig. 8: Effect of press load on punch travel of Diall 50-01, using 175-g. charge

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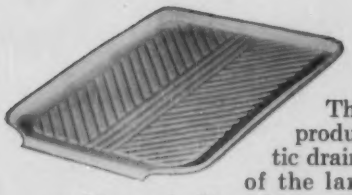

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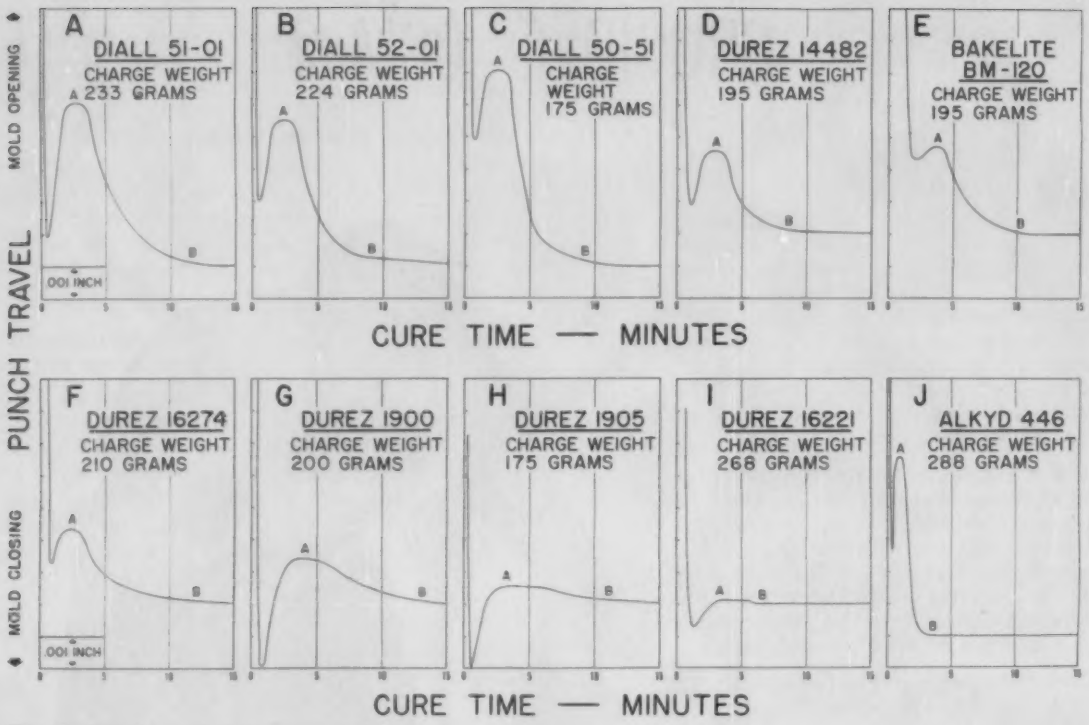

Fig. 9: Punch travel of various materials

face of the part before the thermal expansion in the center is complete. The relationship between chemical shrinkage and molding shrinkage was investigated later in the program.

Notice that the apparent chemical shrinkage begins (Point *A*) later in the molding cycle as the charge weight is increased because of the larger bulk of the specimen and the resulting reduced rate of temperature rise. Note also that Point *B* shows a similar tendency.

The effect of electronic preheating of Diall 50-01 on the punch-travel is shown in Fig. 7, p. 180. The upper curve represents a part made with no preheat and the lower represents a part preheated electronically to 210° F. before molding. In both cases, a charge weight of 175 g. and a press load of 50 tons were used. The lower curve is displaced 0.008 in. below the upper. (Punch-travel scale here is continuous, unlike that of Figure 6.) This displacement is accounted for by the fact that the preheated material had greater plasticity so that more material flashed past the punch and was eliminated from the cavity. The final weights of the two parts were 172.8 and 169.1 g., respectively (a difference of 3.7 grams). On a volumetric basis, the height[3] of the preheated part should be $(3.7/172.8) \times 0.360 = 0.008$ in. less than that of the non-preheated part. This difference is in excellent agreement with the actual result. Notice also that there is little difference in shape between the two curves and that preheating did not appear to decrease either the apparent chemical shrinkage or the time of cure. With this material the principal effect of preheating, therefore, was to increase material plasticity.

The effect of press load on the shape of punch-travel curves for Diall 50-01 is shown in Fig. 8, p. 180. Corrections for mold deflection were determined by placing a steel disk in the cavity in place of the molding compound and recording the deflection at the various molding pressures. Before plotting the data, these corrections were subtracted from the values obtained in molding. The parts represented in the graphs both had charge weights of 175 grams. The final weights were 173.1, 172.7, 172.8, and 172.6 g. for molding pressures of 1000, 2500, 5000, and 7500 p.s.i., respectively (based on the area of the part). The difference between final weights is so slight that it accounts for only a small part of the vertical displacement of the curves. The major part of this displacement was due to the greater compression of the material at the higher pressures.

The difference in height between Points *A* and *B* in these curves (Fig. 8) decreases as the press load is increased. This decrease is possibly due to the increasing effect (with pressure) *of the difference* in compressibility between the uncured and cured states corresponding to Points *A* and *B*.

Punch-travel curves — other materials: Punch-travel tests were also made for several materials with 50 ton (5000 p.s.i.) press loads and a charge weight

(*To page* 294)

[3]The approximate height of the part in the mold is 0.360 inch, and the part can expand only in the height direction. Density is assumed to be the same for molding with or without preheat.

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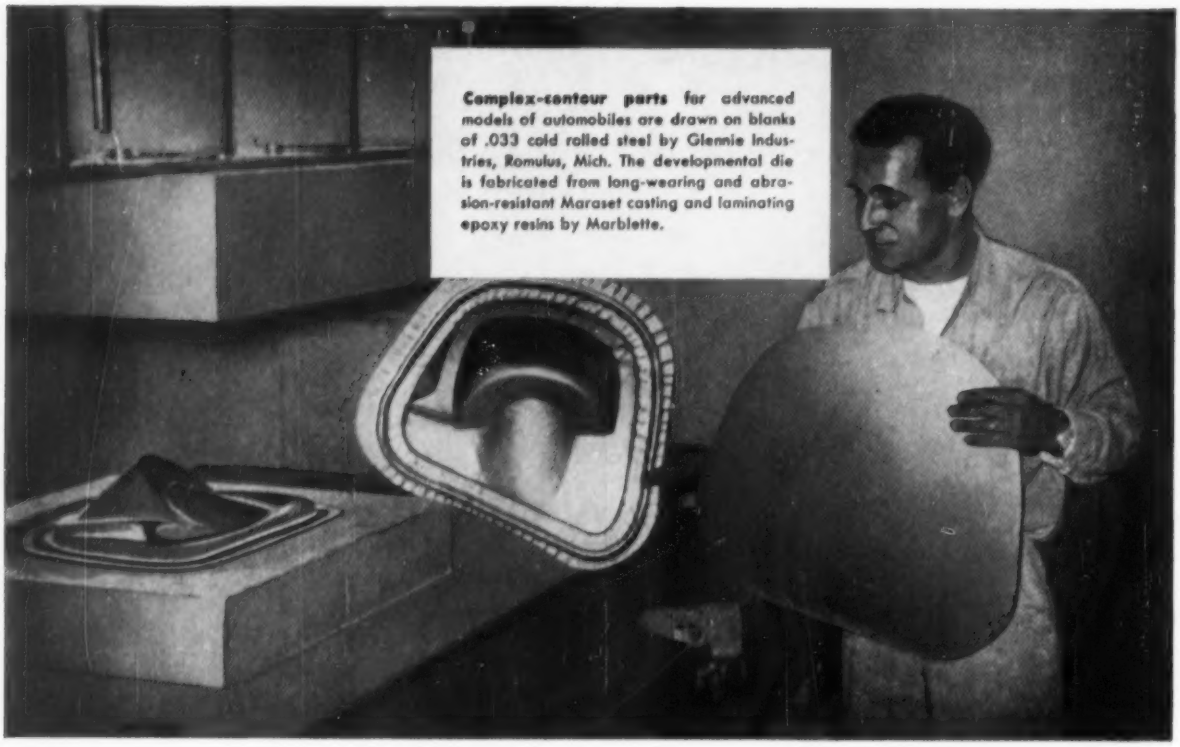

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Plastics Technical Section

Dr. Gordon M. Kline, Technical Editor

Temperature-property relations in melamine- and silicone-glass fabric laminates

A study of creep, stress-rupture, and static properties

By William N. Findley[†], Harlan W. Peithman[‡], and Will J. Worley[**]

Results of static tension, static compression, tension creep, and time-to-fracture tests of melamine- and silicone-glass fabric laminates at temperatures up to 400 and 600° F., respectively, are reported.

The mechanical properties of both laminates decreased in desirability with increase in temperature as a rule.

The creep data supply additional evidence that the percent increase in strain from one given time to another given time (called creepocity) is independent of stress. An analysis of the creep data is presented by an equation which describes the effect of stress, time, and temperature. This equation is based on the activation energy theory and a power function of time.

An analysis of the data shows the possibility that no creep will occur at temperatures below —10° F. for the melamine laminate and —119° F. for the silicone laminate.

The series of tests reported herein is a part of a coordinated research program to investigate the effect of temperature on the mechanical properties of plastic laminates for use in aircraft construction. Reports of some previous investigations of this problem are listed (1-9).[1]

The following tests were performed at various temperatures on each of the two glass fabric laminates: short-time static tension and compression tests, creep tests of 500-hr. or longer duration with recovery data taken at the end of each test, time-to-fracture tests in which the elapsed time, between application of the load and fracture of the specimens, was determined for various stresses.

Materials and specimens

Two plastics were tested in this program: a melamine resin-glass fabric laminate and a silicone resin-glass fabric laminate. The details of manufacture and composition of each material appear in reference 10. Dimensions of specimens for each type of test performed are illustrated in Fig. 1, p. 187. All specimens were cut from the sheet of laminate with their longitudinal axes parallel to one another.

Two types of creep and time-to-fracture specimens shown in Figs. 1c and 1d were used for temperatures in the 40 to 250° F.

*Reg. U. S. Pat. Off.

[1]Numbers in parentheses link to references at end of article, p. 206.

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[‡]Research Dept., Ford Motor Co., (formerly at University of Illinois)

[**]Assistant Professor of Theoretical and Applied Mechanics, University of Illinois.

This work was conducted at the University of Illinois under the sponsorship and with the financial assistance of the National Advisory Committee for Aeronautics. Credit is due to American Cyanamid Co., Dow Corning Co., General Electric Co., and Taylor Fibre Co., for preparing laminates and providing information pertaining to the composition and manufacturing conditions of the two materials tested.

The assistance of H. E. Anderson, J. P. Cedarholm, G. E. Chicoine, J. H. Dabbert, R. E. Duff, B. K. Ghandi, S. C. Hu, L. B. Kriz, P. N. Mathur, J. B. Pennington, R. P. Quinlan, R. C. Quinlan, L. H. Shanin, D. D. Strohbeck, L. B. Taplin, and J. R. Young in performing tests, making computations, and preparing drawings, and D. Bailey in machining specimens and apparatus is gratefully acknowledged.

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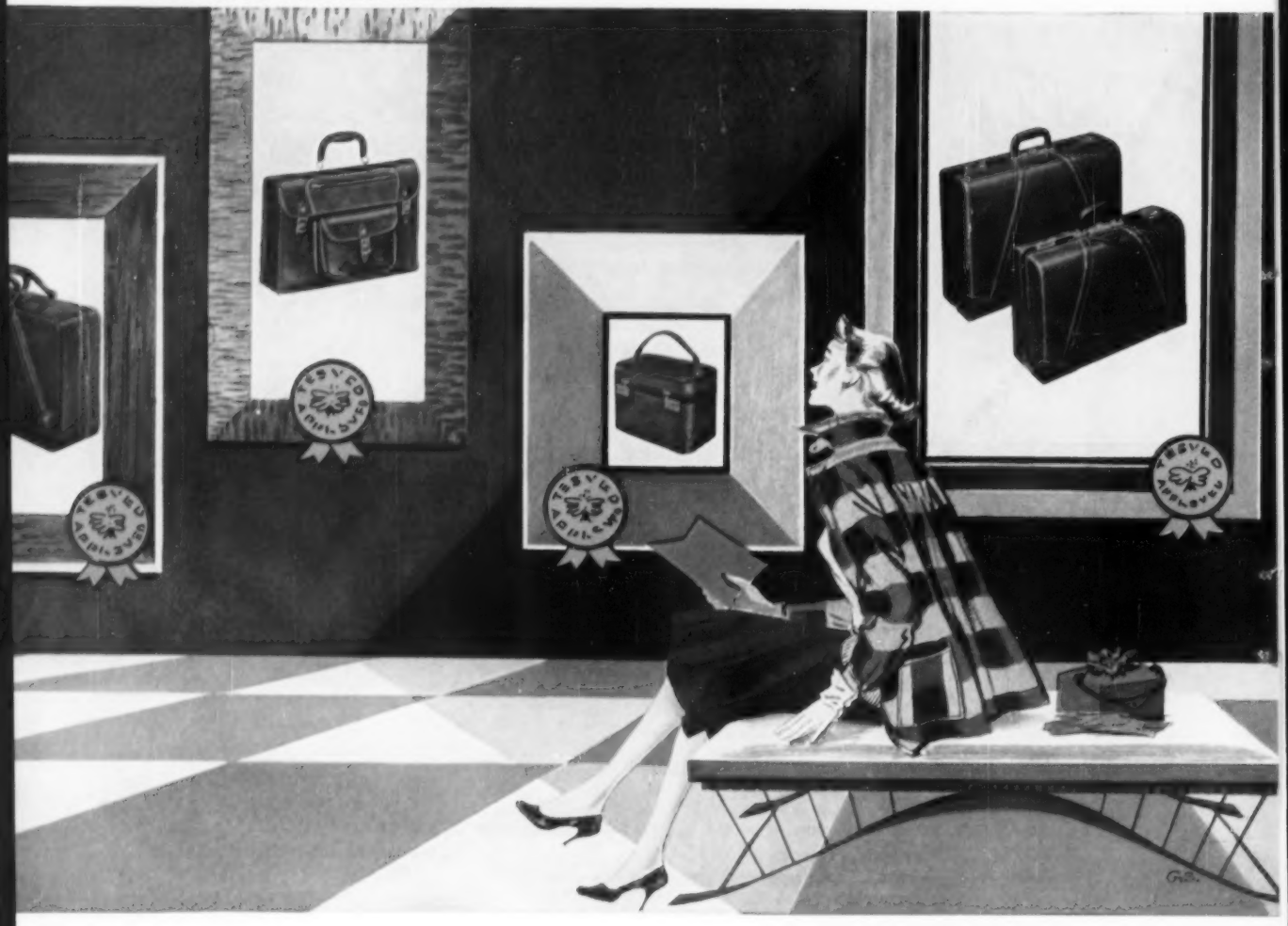

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range. The first type used, Fig. 1d, proved satisfactory for a small load on the specimen; however, for a large load there was a tendency for the specimen to fail prematurely at the enlarged sections where the specimen was gripped. Failure at the grips was overcome by changing the shape of the ends of the specimen as represented by the diagram shown in Fig. 1c.

For temperatures between 400 and 600° F. a different type of creep specimen was used to fit the high-temperature Baldwin creep machine. Specimens with threaded ends and a circular cross-section, Fig. 1e, were adopted after some preliminary work with a type having threaded ends and a rectangular cross-section. The rectangular cross-section was the same as that used in the low temperature creep specimens.

All specimens were kept in the air-conditioned laboratory for at least 2 wk. prior to the start of a test. This laboratory was maintained at a temperature of 77 ±1° F. and a relative humidity of 50 ±2% throughout the entire testing program.

The apparatus, test procedures, and types of fracture obtained are described in detail in reference 10.

Static tension tests

A summary of all the mechanical properties determined for both glass-fabric laminates during this investigation is presented in Table I, p. 188. The tensile properties are given in items 3 to 7. Representative stress-strain curves in tension at different temperatures for the laminates are shown in Figs. 2, below, and 3, p. 190, together with a sample time-strain curve.

It was observed that the melamine laminate had a higher tensile modulus of elasticity at all comparable temperatures. For both materials the modulus of elasticity generally decreased for increased temperatures. The melamine resin material showed a change in the slope of the stress-strain diagram at a stress of 6000 p.s.i. or less for all four temperatures. The slope below this point was called the primary modulus

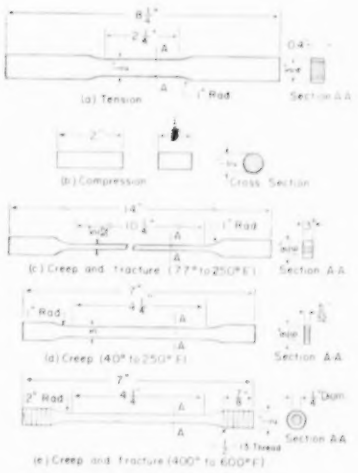
(a) Tension
(b) Compression
Cross Section
Section A-A
(c) Creep and fracture (77° to 250° F)
(d) Creep (40° to 250° F)
(e) Creep and fracture (400° to 600° F)

Fig. 1: Static and creep specimens. Cross-hatched lines indicate planes of laminations

of elasticity and the slope above was called the secondary modulus of elasticity. These values are given as items 3 and 4 in Table I. A similar change in slope was noted for the glass fabric laminate made with an unsaturated polyester resin reported on page 15 of reference 8.

The tensile yield strength did not show a systematic variation with temperature for either glass laminate. The highest tensile yield strength (12,700 p.s.i. at 0.05% offset and 26,600 p.s.i. at 0.2% offset) for the melamine laminate occurred at 250° F. The tensile yield strength of the silicone laminate was greatest at 77° F. (10,100 p.s.i. at 0.05% offset). No tensile yield strength at 0.2% offset was obtained at 77° F. since the stress-strain curve did not cross the 0.2% offset line.

The tension modulus of elasticity of the melamine laminate was 25% lower at 400 than at 77° F. For the silicone laminate the tension modulus of elasticity was 23% lower at 600 than at 77° F. Considering the high and low values, the tensile yield strength of the melamine laminate at 0.05% offset was lower at 77 and 130° F than at 250° F. by 15 percent. The tensile yield strength at 0.2% offset was 17% greater at 250 than at 400° F. The silicone laminate showed a tension yield strength at 0.05% offset 49% less at 600 than at 77° F.

The tensile ultimate strength was smaller by 16% at 250 than at 77° F. for the melamine laminate. For the silicone laminate the tensile ultimate strength was found to be 21% less at 600 than at 77° F.

Comparisons of melamine- and silicone-glass fabric laminates with the five laminates tested in reference 4 shows that the melamine material demonstrated higher tension properties by 8% than any of the five laminates tested previously at 77° F. However, the ultimate compressive strength of the melamine laminate was 43%

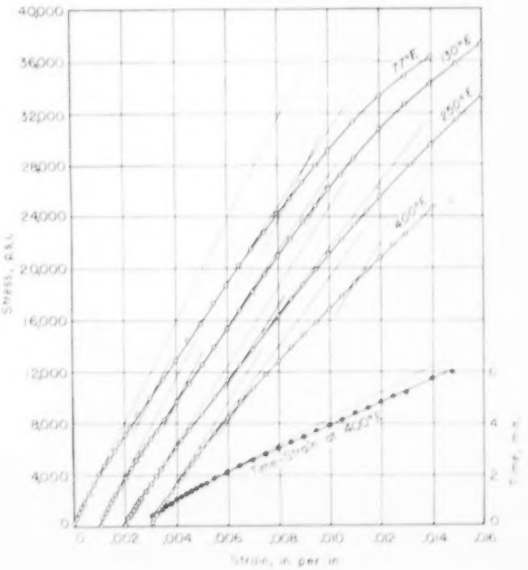

Fig. 2: Representative stress-strain curves for tension tests of a melamine resin-glass laminate

Table I: Summary of mechanical properties determined for the glass fabric laminates

Property	Melamine laminate				Silicone laminate			
	77°F.	130°F.	250°F.	400°F.	77°F.	250°F.	425°F.	600°F.
1. Laminating conditions	1,250 p.s.i. at 284°F. for 1 hr.				1,800 p.s.i. at 485°F. for 3 hr.			
2. Specific gravity	1.90	—	—	—	1.68	—	—	—
3. Tension modulus, primary, 10^6 p.s.i.	3.85	3.70	3.06	2.97	2.01	1.90	1.58	1.57
4. Tension modulus, secondary, 10^6 p.s.i.	2.94	2.94	2.56	2.62	—	—	—	—
5. Tension yield strength at 0.05% offset, p.s.i.	10,800	10,800	12,700	11,300	10,100	5,700	6,200	5,100
6. Tension yield strength at 0.2% offset, p.s.i.	26,500	26,000	26,600	22,000	[a]	12,000	8,300	6,600
7. Ultimate strength in tension, p.s.i.	43,200	39,400	36,000	36,600	16,400	14,700	13,700	12,900
8. Compression modulus, 10^6 p.s.i.	3.97	3.83	3.11	2.73	2.38	2.05	1.71	1.49
9. Compression yield strength at 0.05% offset, p.s.i.	23,800	18,000	11,500	9,600	7,600	4,600	3,100	2,700
10. Compression yield stress at 0.2% offset, p.s.i.	[a]	[a]	14,800	12,100	[a]	5,800	3,700	3,000
11. Ultimate strength in compression, p.s.i.	25,700	20,900	16,200	13,600	11,300	5,900	3,700	3,100
12. Total creep at 500 hr. for stresses noted, %	0.4256[b]	0.4882[b]	0.60[b]	0.92[b]	0.385[c]	0.5296[c]	0.670[c]	0.947[c]
13. Average for creep tests at several stresses of the increase in strain 20 sec. to 500 hr., %	6.69	16.3	34.8	59.0	17.7	41.4	40.8	83.6
14. Rate of creep at 500 hr. for stresses noted, 10^{-7} in./in.-hr.	1.62[b]	2.70[b]	5.0[b]	44.0[b]	2.3[c]	4.9[c]	8.8[c]	30.5[c]
15. 20 second elastic strain at stress noted, %	0.4004[b,d]	0.4225[b]	0.47[b]	0.55[b]	0.315[c]	0.3980[c]	0.445[c]	0.448[c]
16. 20 second recovery strain at stresses noted, %	0.3837[b,e]	0.4080[b]	0.43[b]	0.495[b]	0.31[c]	0.3604[c]	0.365[c]	0.3620[c]
17. Creep strength at 200 hr., p.s.i.	33,300	32,800	33,200	29,200	9,700	9,300	11,500	11,800

[a] The stress-strain curve did not cross the 0.2% offset line before fracture.
[b] 12,000 p.s.i. stress
[c] 6,000 p.s.i. stress
[d] 0.3944% at 40°F.
[e] 0.3858% at 40°F.

smaller than the glass fabric laminate bonded with the unsaturated polyester resin. The silicone laminate showed lower tension and compression values than the unsaturated polyester resin laminate at 77° F.

Static compression tests

The static compression properties are summarized in Table I, items 8 to 11. Representative stress-strain curves and a sample time-strain curve are shown in Figs. 4 and 5. The compression modulus of elasticity for the melamine laminate is greater than the tension modulus at all temperatures except 400° F. The greatest difference between compression and tension moduli is 6%, occurring at 400° F. For the silicone laminate the compression modulus is greater than the tension modulus by no more than 15% for any temperature except for 600° F., in which case the compression modulus was found to be less than the tension modulus by 4 percent.

The compression yield strength of both materials decreased with increased temperature. The stress-strain curve did not cross the line at 0.2% offset at 77° F. for either material. The compression yield strength for the highest temperature test was 60% and 66% less than the 77° F. values for the melamine and silicone laminates, respectively. Ultimate strengths decreased with temperature increase for both materials. At the highest temperatures the ultimate strength was 47% and 74% less than at 77° F. for the melamine and silicone laminates, respectively.

Ultimate strengths in compression for all temperatures and for both materials were considerably less than the corresponding ultimate strength in tension. The compression ultimate strength of melamine resin is 41% and 63% less than the tensile ultimate strength at 77 and 600° F., respectively.

For equal temperatures the melamine-glass fabric laminate demonstrates higher tension and compression properties than the silicone-glass fabric laminate. This is no doubt due in part to the comparative number of plies per unit thickness of the two laminates (62 approximately for the melamine laminate as compared to only 45 plies for the silicone laminate).

Tension creep tests

Results of creep tests for each of the two materials at several temperatures and stresses are shown in Figs. 6 through 14 for the first 500 hr. of creep followed by strain recovery curves for those specimens that were unloaded after 500 hr. under load. The tests at 77° F. were extended to greater lengths of time. The differences in the two materials made it impractical to plot each set of data to the same scale. However, uniformity in scales was maintained wherever possible.

In general, the rate of creep was very large at the beginning of each test and continuously decreased as time progressed. The total creep at any given time and stress was greater at higher temperatures, and the total creep at any given time and temperature was greater for larger stresses.

A control specimen was tested along with the creep specimens;

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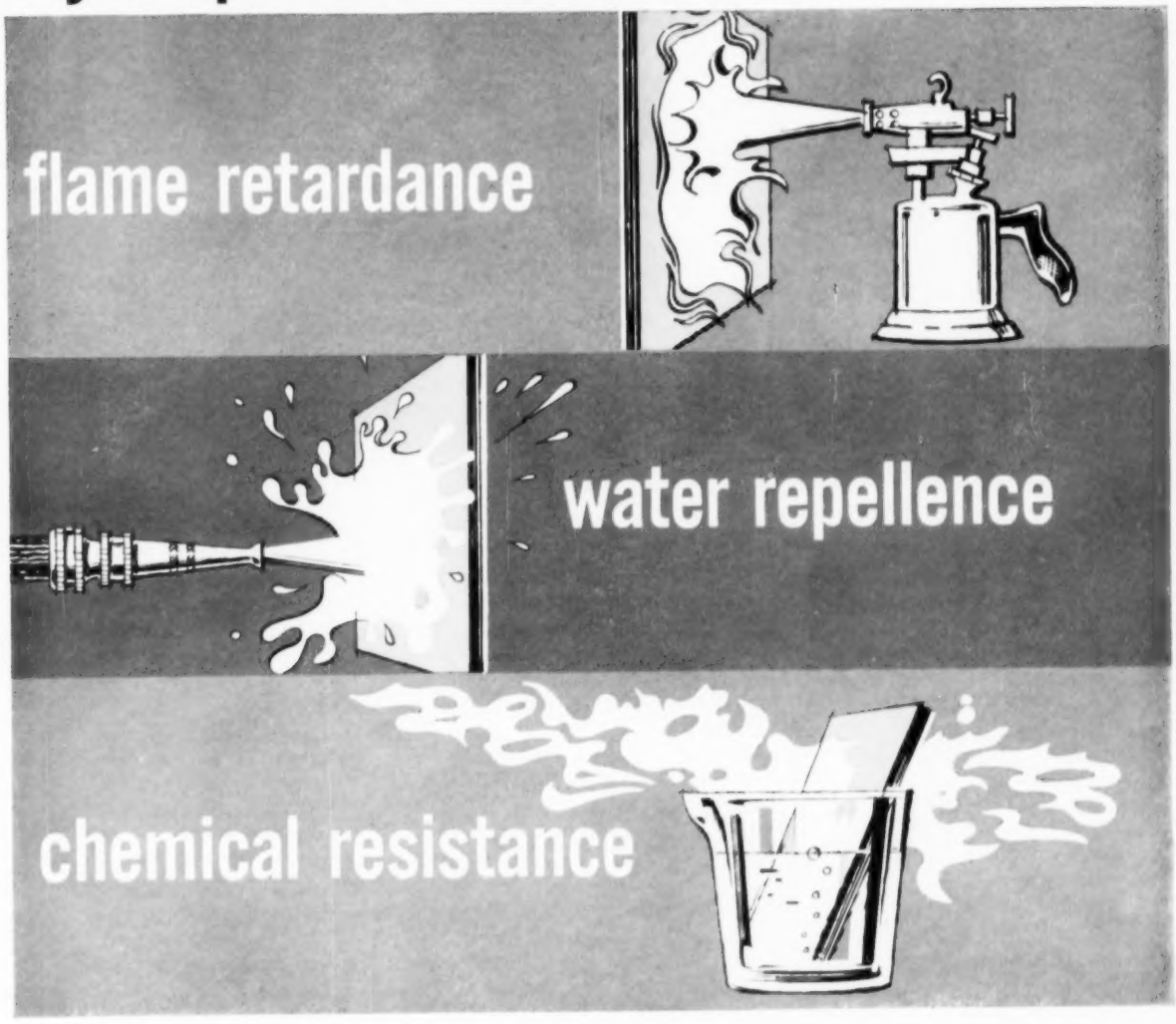

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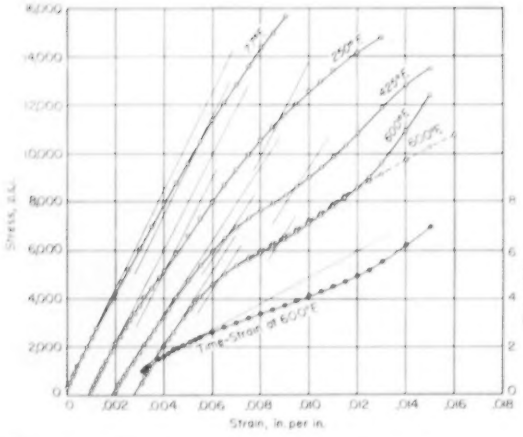


Fig. 3: Representative stress-strain curves for tension tests of a silicone-glass fabric laminate. (See text for explanation of dashed line)

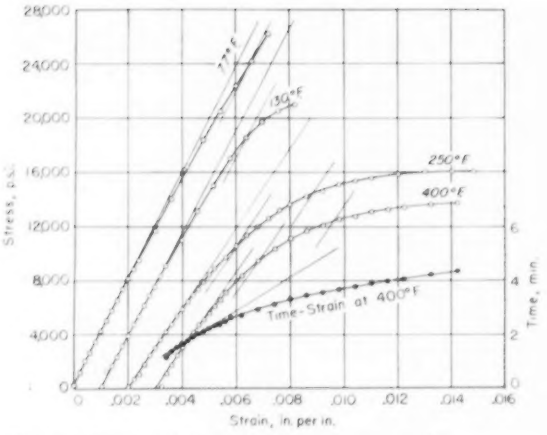


Fig. 4: Representative stress-strain curves for compression tests of a melamine resin-glass fabric laminate

these specimens were not loaded but strain readings were recorded in order to determine whether the material was stretching or shrinking due to other factors than creep.

The control specimens for the melamine material showed very little change in length; no consistent trend was evident over the range of temperatures employed. The silicone material on the other hand showed little change in length at the lower temperatures, but increasing amounts of shrinkage as the temperature increased above 250° F.

It should be noted, however, that all the control specimens tested in the high temperature creep machine were actually subjected to a stress of 150 p.s.i. This was due to the weight of the lower gripping apparatus and extensometer. While a stress of 150 p.s.i. is small (compared to the stress of 4000 p.s.i. present in the specimen of next higher stress) it may have affected the observed changes in length.

Difficulties were encountered at high temperatures which were not problems at low temperatures. In addition to the problem of maintaining a constant temperature and a uniform temperature distribution along the specimen at higher temperatures, each specimen was tested separately, so that temperature variations and other changing conditions occurring in the zero- stress control specimen were not reflected in the behavior of specimens of the same test series, as was true of the groups of specimens tested together in the same furnace.

The rate of creep did not remain constant throughout the time of testing but decreased rapidly at first and then more gradually. In order to evaluate the effect of stress on the different rates of creep, the rate of creep was determined for a time of 500 hr. by first correcting the data for change in length as indicated by the control specimen. The rate of creep was determined by measuring the slope of the curve represented by the test data between a time of 450 and 550 hr. The measurements were made from a logarithmic plot in which the strain scale was extended to 25 to 50 times the time scale in order to increase the accuracy of the slope measurements. The rate of creep thus obtained for each specimen is shown in Figs. 15 and 16, p. 194. Because of the disturbance at 200 hr. shown in Fig. 6, the rate of creep for 40° F. could not be determined.

The elastic strain at 20 sec. and the total strain at 500 hr. corrected for change in length due to aging at the particular test temperature are shown plotted in Figs. 17 and 18, p. 194, for all temperatures.

The curves for the 20-sec. elastic strain may be compared with the stress-strain curves in tension, Figs. 2 and 3, respectively, except that the coordinates are reversed. For the melamine laminate, the 20-sec. elastic strain curves and stress- strain curves are quite similar except that the strains from the creep tests are somewhat greater. This may result from the fact that the creep specimens were at temperature for 24 hr. (compared to 30 min. for the tension tests) before testing.

For the silicone laminate, the 20-sec. elastic strain curves and stress-strain curves are about the same except for the higher stresses at 425 and 600° F. where the strains are much larger in the tension tests. This difference may be due to the longer time under load in the tension tests or it may be due to the longer time at tem-

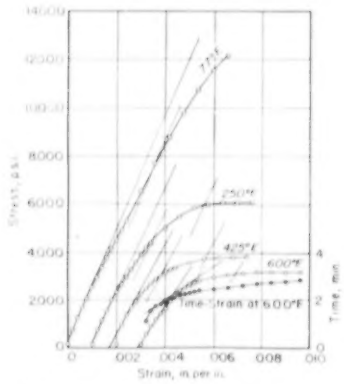
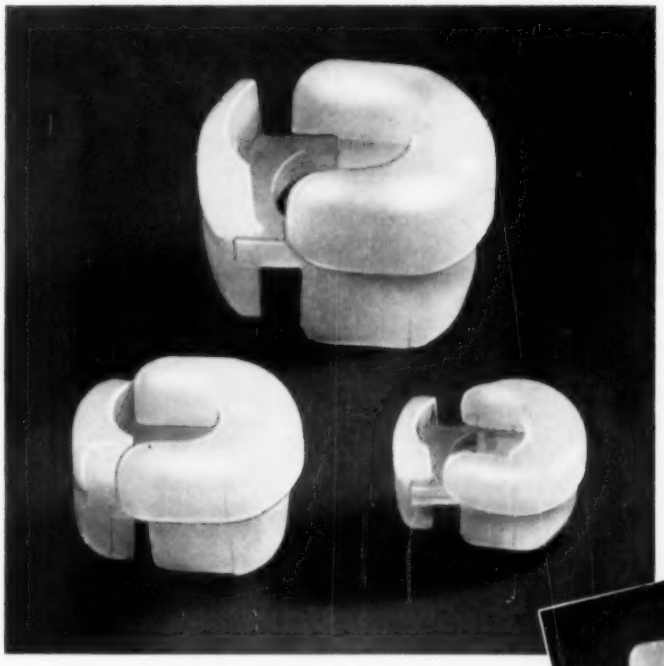


Fig. 5: Representative stress-strain curves for compression tests of a silicone resin-glass fabric laminate



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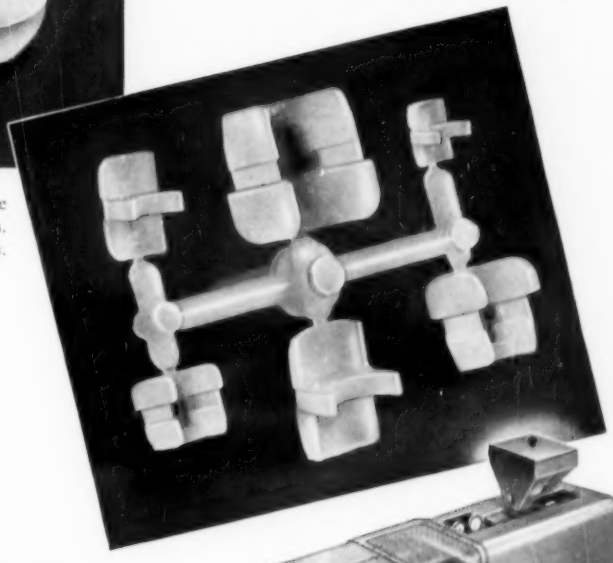

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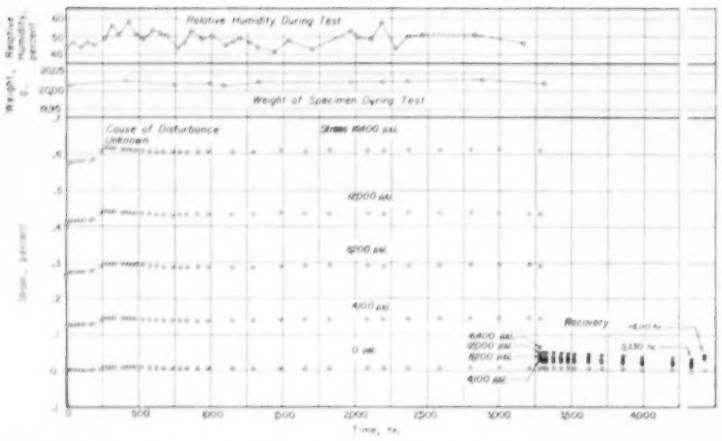

Fig. 6: Creep-time curves for tension creep tests of a melamine resin-glass fabric laminate tested at 40° F.

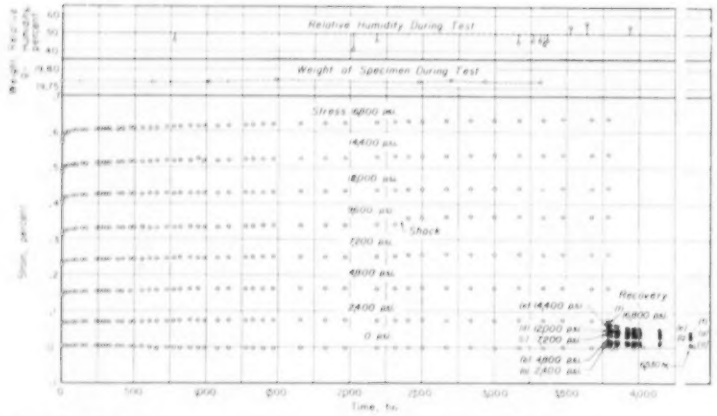

Fig. 7: Creep-time curves for tension creep tests of a melamine resin-glass fabric laminate tested at 77° F.

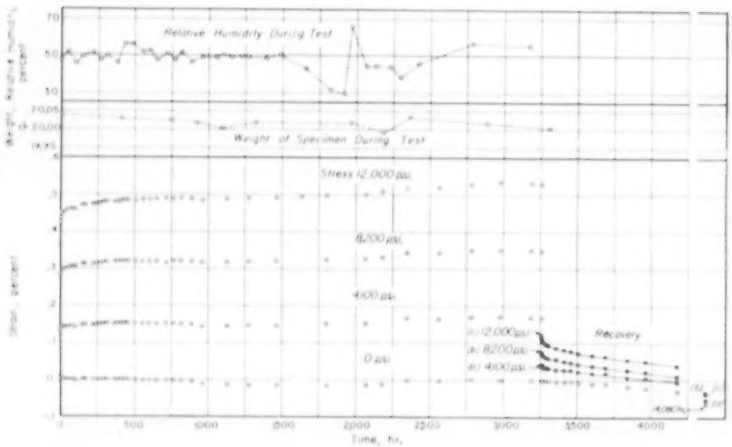

Fig. 8: Creep-time curves for tension creep tests of a melamine resin-glass fabric laminate tested at 130° F.

perature prior to testing in the creep tests.

Using the moduli of elasticity as a basis for comparison, the moduli of elasticity determined from the 20-sec. strain data for tension creep tests are less than the moduli of elasticity of the static tension data for all temperatures and both materials enumerated in percentages as follows: for the melamine laminate at 77, 130, 250, and 400° F. the tension creep moduli of elasticity are less by 15, 14, 9, and 23%, respectively; for the silicone laminate at 77, 250, 425, 600° F. the tension creep moduli of elasticity are less by 4, 12, 9, and 12% respectively. The differences in moduli of elasticity may be attributed partially to dissimilarity of the time factor.

Recovery data taken for both materials made possible a determination of the strain at 20 sec. after unloading. These are illustrated in Table I, item 16. Comparisons of 20-sec. recovery strain and 20-sec. elastic strain shows that the recovery strain was somewhat less than the elastic strain for all temperatures and about ¾ of the elastic strain for the silicone laminate at 600° F.

Creepocity: The percent increase in strain from 20 sec. to 500 hr. is shown in Table I, item 13, as an average for several stresses. These data (detailed in reference 10) seem to verify the proposals in references 6 and 8 that the percent increase in strain, called creepocity in earlier work, is nearly independent of stress at any temperature. It was observed that the creepocity became greater for increased temperatures for both materials, indicating increasingly poor resistance to creep. In spite of a large amount of scatter in the data at higher temperatures for both materials, it was evident that there was no systematic variation with stress.

As suggested in references 6 and 8 the following equation may express the creep behavior. Used with reasonable success in previous work it is now applied to the data involving higher temperatures.

$$\epsilon = \epsilon_0 [1 + (t/t_0)^n] \qquad \text{Eq. 1}$$

where ϵ is total strain, in./in., ϵ_0 is

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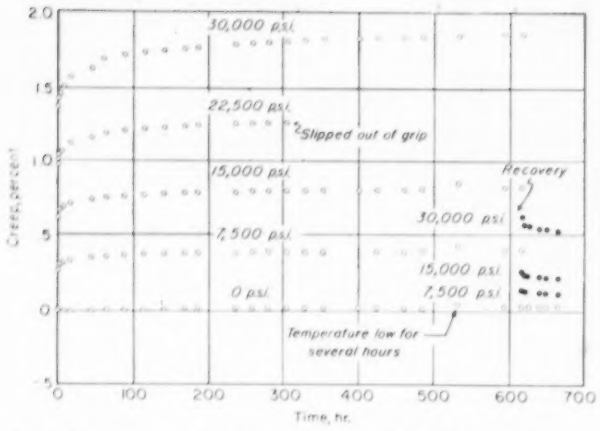


Fig. 9: Creep-time curves for tension creep tests of a melamine resin-glass fabric laminate tested at 250° F.

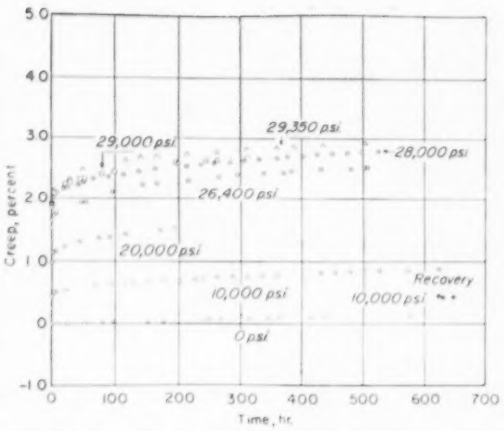
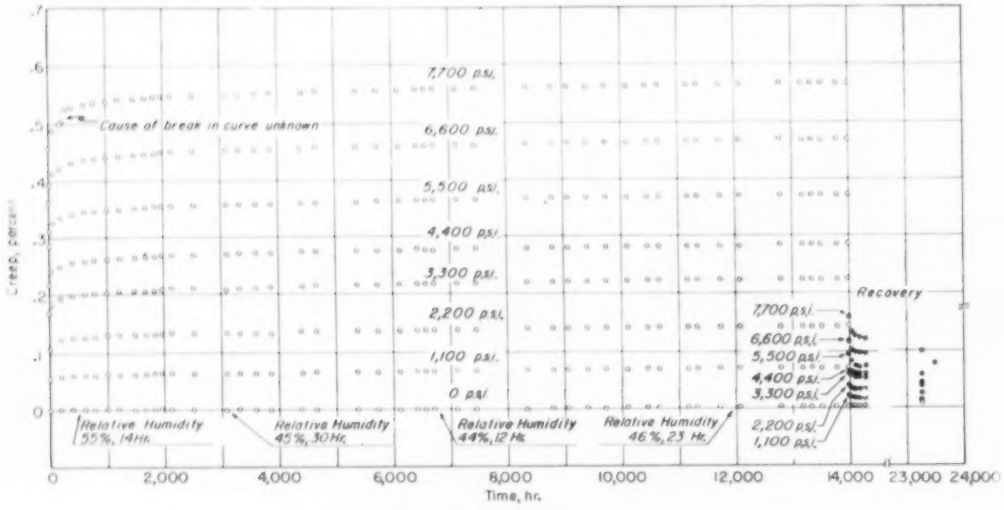
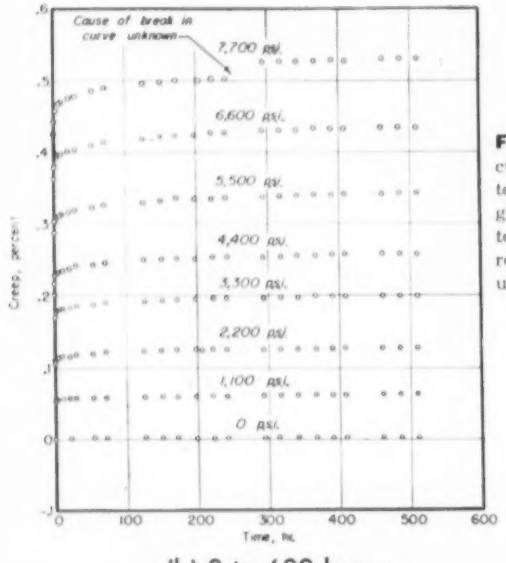


Fig. 10: Creep-time curves for tension creep tests of a melamine resin-glass fabric laminate tested at 400° F.



(a) 0 to24,000 hours



(b) 0 to 600 hours

Fig. 11: Creep-time curves for tension creep tests of a silicone resin-glass fabric laminate tested at 77° F. and a relative humidity of 50%, unless otherwise noted

time-independent strain in in./in., t is time in hr., t_0 is a constant conveniently taken equal to unity and having the dimensions of time in hr., and n is a constant independent of stress and dimensionless.

It follows from Eq. 1 that the creepocity ϕ, which is the percent increase in strain from t_1 to t_2, may be expressed by the following:

$$\phi_{1,2} = \frac{(t_2/t_0)^n - (t_1/t_0)^n}{1 + (t_1/t_0)^n} 100 \quad \text{Eq. 2}$$

Exponent n: Using the average percent increase in strain from 20 sec. to 500 hr. shown in Table I the values of n were computed from Eq. 2 for each temperature for both laminates. Comparing

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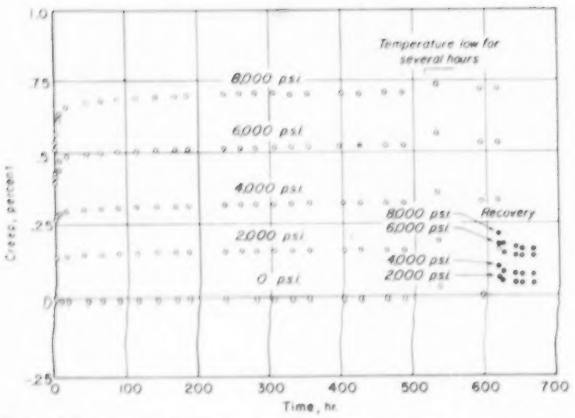


Fig. 12: Creep-time curves for tension creep tests of a silicone resin-glass fabric laminate tested at 250° F.

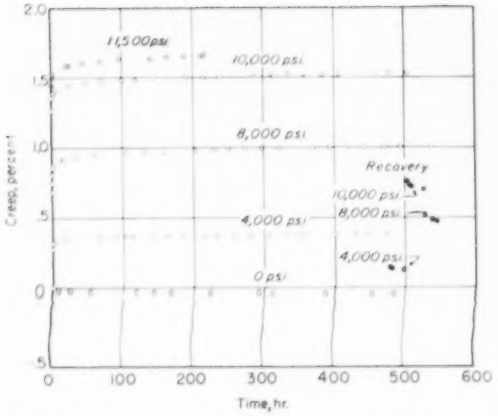


Fig. 13: Creep-time curves for tension creep tests of a silicone resin-glass fabric laminate tested at 425° F.

this set of values of n for the melamine laminate with a set previously determined (6) on the same material between 20 sec. and 1000 hr. of creep, the values of n as determined between 20 sec. and 500 hr. were found to be smaller by 39 and 6% for 77 and 130° F., respectively. There is a good possibility that the comparatively poor agreement at 77° F. may have been partially caused by the larger scatter of values of creepocity computed between 20 sec. and 1000 hours. Of this scatter the largest value of creepocity was 2½ times greater than the smallest. Another possibility is that Eq. 1 does not fit the creep data accurately enough.

Time-independent term ε_0: The value of ε_0 was determined by substituting values of n into Eq. 1 using values of ε at 20 sec. (ε_1) and 500 hr. (ε_2). Comparing the average value of ε_0 determined from ε_1 and ε_2 for the melamine laminate with data from reference 6 in which ε_0 was calculated in the same manner using values of n determined from 20 sec. and 1000 hr. at 77 and 130° F., the agreement was found to be reasonable. The differences were less than 3% at 77° F. except at 2400 p.s.i. which rendered an ε_0 computed from 20 sec. and 500 hr. less by 7% than the ε_0 computed from 20 sec. and 1000 hours. None of the ε_0 values at 130° F. varied more than one percent. Similar comparisons were not made on the silicone laminate since no previous computations of this nature had been performed on this material.

Calculated creep rates: If the strain ε at any time is accurately defined by Eq. 1, then the creep rate $\dot{\varepsilon}$ can be determined by differentiating Eq. 1 as follows:

$$\dot{\varepsilon} = \frac{d\varepsilon}{dt} = \frac{\varepsilon_0 n}{t_0} (t/t_0)^{n-1} \qquad \text{Eq. 3}$$

Creep rates at 500 hr. computed from Eq. 3 by substituting the values of ε_0 and n determined above are shown in Tables II, p. 204, and III, p. 206, for comparison with other creep rates at 500 hours. For the most part, the creep rates computed from Eq. 3 are much more consistent in stress dependence than the measured values. This is especially true of melamine resin at 77° F. for which the measured values produce a scattering of data as shown in Fig. 15.

Effect of temperature on exponent n: Fig. 19, p. 200, shows constant n plotted against absolute temperature for both materials. The data shown in Fig. 19 suggest that n may be a linear function of absolute temperature and suggest the possibility that n has a value of zero at temperatures about zero absolute. If the straight lines shown in Fig. 19 are extrapolated to n = 0, the lines intersect the x-axis at 250° K (−10° F.) for the melamine laminate and 189° K. (−119° F.) for the silicone laminate. The fact that the lines shown in Fig. 19

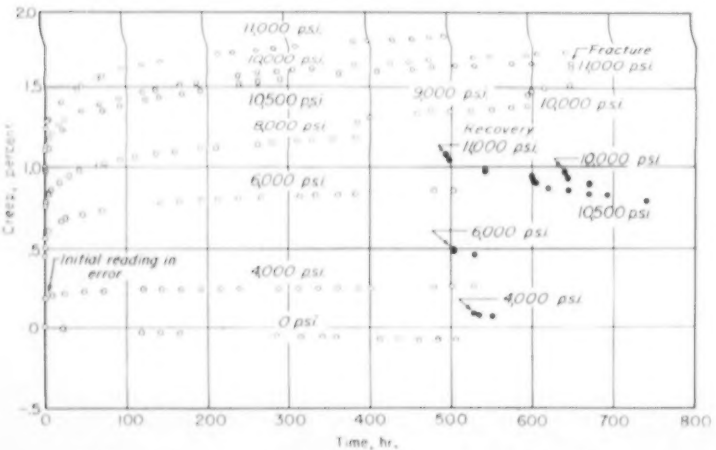
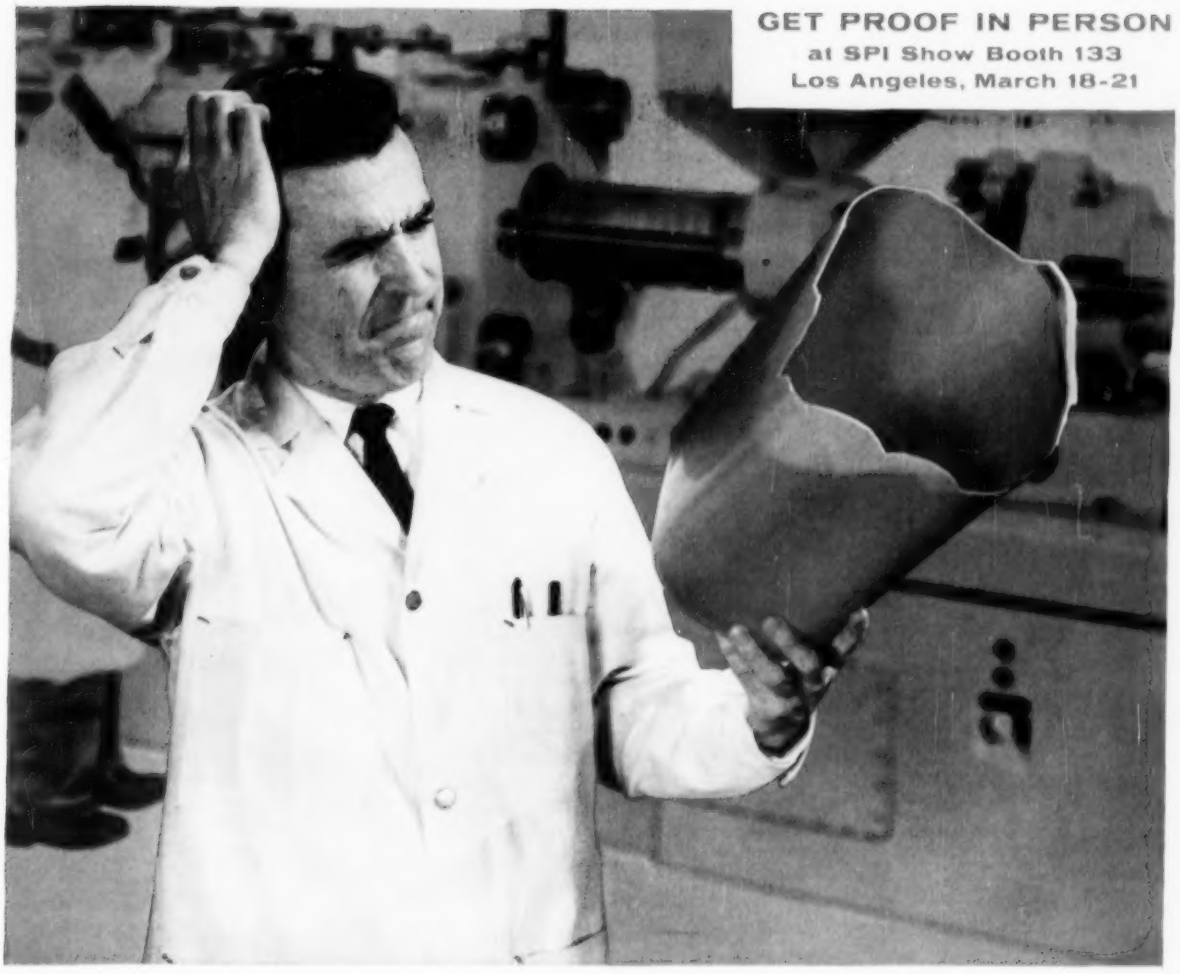


Fig. 14: Creep-time curves for tension creep tests of a silicone resin-glass fabric laminate tested at 600° F.



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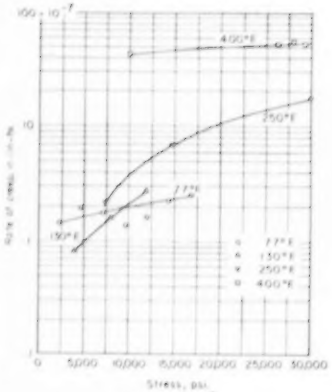


Fig. 15: Rate of creep at 500 hr. versus stress at various temperatures for a melamine resin-glass fabric laminate. Data corrected for change in length of specimen carrying zero load

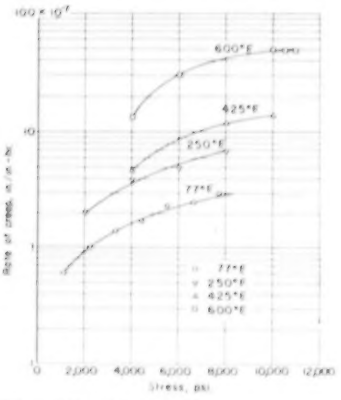


Fig. 16: Rate of creep at 500 hr. versus stress at various temperatures for a silicone resin-glass fabric laminate. Data corrected for shrinkage

for the two laminates are nearly parallel is noteworthy.

In view of Eq. 1 it would seem that these materials would show no creep (that is no time effect) at the temperatures indicated above since n = 0. It would be interesting to learn whether this is true. A temperature below which creep does not occur for plastics seems possible since many metals do not appear to creep at room temperature. When *n* is negative, Eq. 1 predicts that the strain will decrease with increasing time.

An anomalous behavior is indicated by Eq. 1 when n = 0 in that the strain ϵ equals 2 ϵ_0 for any value of time other than zero (for which the strain is indeterminant).

That the strain ϵ should equal 2 ϵ_0 does not seem too impossible since the 20-sec. elastic strain is approximately twice the value of ϵ_0 for both laminates, especially at the lower temperatures.

Effect of temperature on time independent term ϵ_0. First method: The effects of temperature and stress on the coefficient ϵ_0 are shown in Fig. 20, p. 202. It was shown previously (6) that ϵ_0 could be represented by a hyperbolic sine function of stress of the form

$$\epsilon_0 = \epsilon_0' \sinh \sigma/\sigma_0 \qquad \text{Eq. 4}$$

for the melamine laminate at 40, 77, and 130° F. The values of ϵ_0' and σ_0 for the melamine laminate at 130° F. have been re-evaluated for the best fit to the values of ϵ_0 obtained from the data of 500 hr. and the values of ϵ_0' and σ_0 have been determined for the data from tests of melamine laminate at 250 and 400° F. The values of ϵ_0' and σ_0 are shown in Tables II and III for both materials. In Fig. 20 the solid lines show Eq. 4 using the constants of Tables II and III.

Examination of the values of ϵ_0' and σ_0 shows no systematic variation with temperature. In fact, it might be concluded that both values were independent of temperature and that the variation shown was scatter. However, if ϵ_0' and σ_0 were independent of temperature, all curves for each laminate in Fig. 20 would have to be coincident, which is not the case. Evidently, there is enough uncertainty or scatter in values of ϵ_0 that ϵ_0' and σ_0 cannot be determined accurately.

Second method. Another approach to this problem may be made via the *activation energy theory*. It has been shown previously that the creep rate $\dot{\epsilon}$ can be expressed as a function of absolute temperature *T* and normal stress σ as follows:

$$\dot{\epsilon} = \frac{4}{3}\frac{\lambda k}{L h} T e^{\frac{\Delta S^*}{R}} e^{-\frac{\Delta H^*}{RT}} \sinh \frac{\sigma A l \sigma}{2kT} \qquad \text{Eq. 5}$$

where $\dot{\epsilon}$ is the creep rate in in./in.-sec., *T* is the absolute temperature in °K., ΔS^* is the entropy of activation in cal./mole-°K., ΔH^* is the energy of activation in cal./mole, σ is the normal stress in dynes/sq. cm., k is the Boltzmann constant (1.3805×10^{-16} ergs/°K.), h is the Planck constant (6.624×10^{-27} erg-sec.), R is the gas constant (1.986 cal./mole-°K.), λ, L, and A are dimensions of the "unit of flow," q = a stress concentration factor,

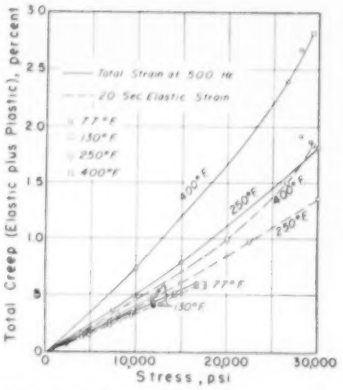


Fig. 17: Effect of stress on 20-sec. elastic strain and on total creep at 500 hr. at various temperatures for a melamine resin-glass fabric laminate. Data corrected for change in length of specimen carrying zero load

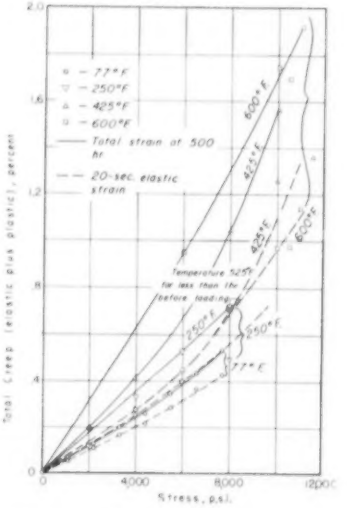
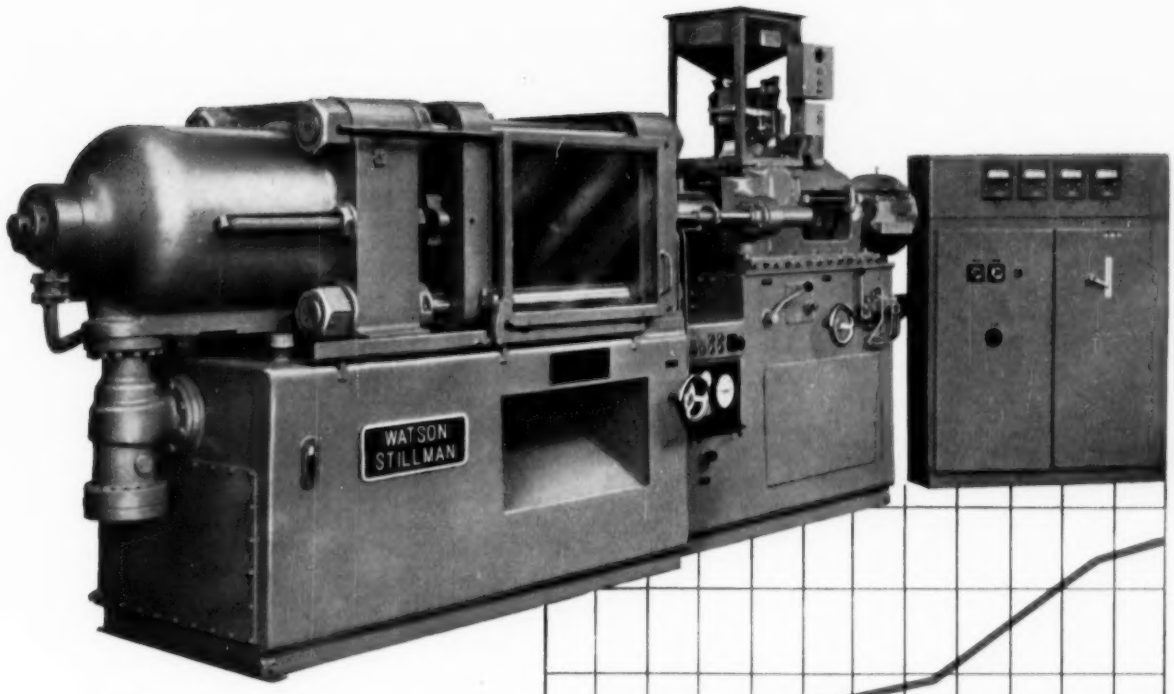


Fig. 18: Effect of stress on 20-sec. elastic strain and on total creep at 500 hr. at various temperatures for a silicone resin-glass fabric laminate. Data corrected for change in length of specimen carrying zero load



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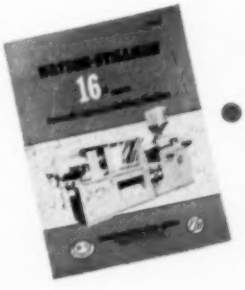

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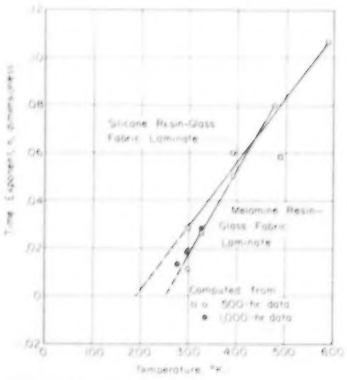

Fig. 19: Time exponent vs. absolute temperature for melamine- and silicone-glass fabric laminate

and l = the distance through which the shear stress acts in carrying the unit of flow from the normal to the activated state.

The creep rate may also be expressed as a function of stress σ and time t by combining Eq. 3 and 4

$$\dot{\epsilon} = \frac{\epsilon_0'^{n}}{t_0}(t/t_0)^{n-1}\sinh \sigma/\sigma_0 \qquad \text{Eq. 6}$$

Eq. 5 may be made more general by introducing the time factor from Eq. 6. Also, it was observed above that n was nearly a linear function of absolute temperature for the two laminates tested and that the slope of the line was nearly the same for both materials. Thus this relation may be written

$$n = \alpha\,(T - T_a) \qquad \text{Eq. 7}$$

where α is a constant presumably independent of material and T_a is the temperature below which the material presumably shows no time sensitivity.

Substituting Eq. 7 in 6 and comparing the result with Eq. 5, it seems reasonable that T in Eq. 5 perhaps should be replaced by $(T - T_a)$ and perhaps α is proportional to $(\lambda/L)\ (kt_0/h)$ since k and h are fundamental physical constants and α is nearly the same for at least two materials. The factor t_0 may be a relaxation time, but in any case it is needed to make n dimensionless, as required. The revised Eq. 5 becomes

$$\dot{\epsilon} = \frac{4}{3t_0}e^{\frac{\Delta S^*}{R}}e^{-\frac{\Delta H^*}{RT}}\frac{\lambda\,kt_0}{L\ h}(T - T_a)\,(t/t_0)^{\frac{\lambda}{L}\frac{kt_0}{h}(T-T_a)-1}\sinh\frac{qAl\sigma}{2kT} \qquad \text{Eq. 8}$$

Comparing Eqs. 8 and 6, the following identities may be found:

$$\epsilon_0' = \frac{4}{3}e^{\frac{\Delta S^*}{R}}e^{-\frac{\Delta H^*}{RT}} \qquad \text{Eq. 9}$$

$$n = \frac{\lambda\,kt_0}{L\ h}(T - T_a) \qquad \text{Eq. 10}$$

$$\sigma_0 = \frac{2kT}{qAl} \qquad \text{Eq. 11}$$

Thus Eq. 8 expresses the creep rate as a function of stress, time, and temperature.

The strain ϵ may likewise be expressed as a function of stress, time, and temperature from Eq. 1 by substituting Eq. 4 for ϵ_0 and substituting Eqs. 9, 10, and 11 for ϵ_0', n, and σ_0, thus:

$$\epsilon = \frac{4}{3}e^{\frac{\Delta S^*}{R}}e^{-\frac{\Delta H^*}{RT}}\left[1 + (t/t_0)^{\frac{\lambda}{L}\frac{kt_0}{h}(T-T_a)-1}\right]\sinh\frac{qAl\sigma}{2kT} \qquad \text{Eq. 12}$$

Substituting Eqs. 9 and 11 into Eq. 4

$$\epsilon_0 = \frac{4}{3}e^{\frac{\Delta S^*}{R}}e^{-\frac{\Delta H^*}{RT}}\sinh\frac{qAl\sigma}{2kT} \qquad \text{Eq. 13}$$

For small values of σ Eq. 13 may be expressed approximately as follows:

$$\epsilon_0 = \frac{2}{3}\frac{qAl\sigma}{kT}e^{\frac{\Delta S^*}{R}}e^{-\frac{\Delta H^*}{RT}}$$

or

$$\log_e \epsilon_0 T = \log_e\frac{2}{3}\frac{qAl\sigma}{k}e^{\frac{\Delta S^*}{R}} - \frac{\Delta H^*}{R}\frac{1}{T} \qquad \text{Eq. 14}$$

Thus, for a small value of stress a diagram of log ϵ_0 T versus 1/T should be a straight line if the temperature dependence of ϵ_0 is as shown in Eq. 13. To test this the values of ϵ_0 for a small stress were computed for each temperature from the values of ϵ_0' and σ_0 given in Tables II and III. These values were used to plot the diagram shown in Fig. 21, p. 202. The disagreement between the data points and the lines shown may be scatter of the data, or it may mean that the behavior of the material is not exactly as described by Eq. 13.

However, the slopes of the lines are of the correct sense. Also the lines are not vertical as would have been required if ϵ_0 were independent of temperature.

The value of the activation energy ΔH^* was computed from the slope of the straight lines shown in Fig. 21. The slope of the line equals $-\Delta H^*/R$, from which ΔH^* was found to be about 1460 cal./mole for both laminates instead of 4500 cal./mole as determined previously (6) for the melamine laminate at 40, 77, and 130° F.

Prediction of previous computations for the melamine laminate:

The constants in Eq. 5 were evaluated from creep of the melamine laminate at 40, 77, and 130° F. and reported in a previous paper (6). It was observed, however, that the value of qAl was not constant according to the data. It is of interest to use the results of the previous analysis to predict the creep rates at 250 and 400° F. for comparison with the measured values.

In making these computations 4/3 λ/L was assumed to be approximately unity since λ and L are presumed to be the same order of magnitude of interatomic distance. Since qAl was not constant in the previous analysis, some assumption had to be made regarding its value. Two assumptions were made: 1) it was assumed that the character of the mechanism of creep was changing in the interval 40 to 130° F. which caused a change in qAl and that the change was completed at 130° F. so that qAl remained constant at 29Å for higher temperatures; 2) it was assumed that qAl varied with temperature. The values of qAl were plotted as a function of temperature to log scales and the resulting straight line was extrapolated to obtain values of qAl at 250 and 400° F.

The values of the constants and qAl were inserted into Eq. 5 and

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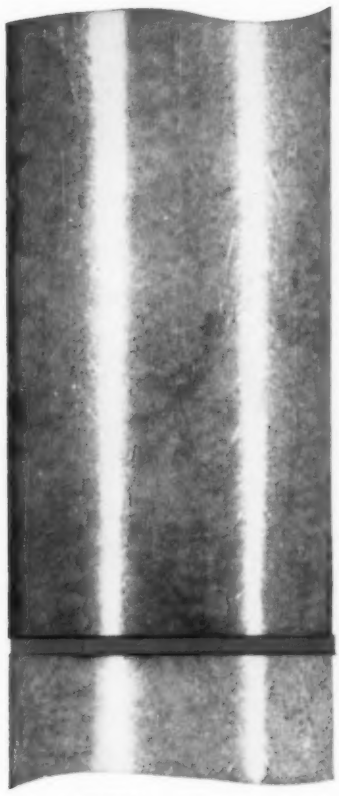

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the values of creep rate were computed. These values are listed in Table II for both methods of handling *qAl*. The creep rates predicted from Eq. 5 for *qAl* a constant are nearest those measured from slopes of the creep curves; and those predicted from Eq. 5 for *qAl* varying with temperature were nearest the values computed from Eq. 3.

Time-to-fracture tests

Results of time-to-fracture tests are shown for the two materials in Figs. 22 and 23, p. 206. The results are scattered for the most part but definite trends are discernible. In general, at a given temperature the time for fracture decreases with increase in stress. It was observed that the slopes decreased as the temperature was increased for both materials. At higher temperatures a small increase in load on a specimen shortened the fracture time considerably. This fact made it difficult at higher temperatures to predict a stress that would cause failure within desired time limits.

Fig. 22 for the melamine laminate shows that increasing the temperature made relatively little difference in the creep strength (i.e., the stress that produced fracture in a given time) for temperatures from 77 to 250° F. However, at 400° F. a decrease in creep strength of about 12% was observed.

A more marked influence of temperature on the silicone laminate was observed, as shown in Fig. 23. Increasing the temperature from 77 to 250° F. caused a decrease in creep strength of about 6%, but increasing the temperature to 425° F. increased the creep strength about 26 percent. Further increase to 600° F. caused a decrease of about 3 percent. Possibly, creep strength may increase with time at temperature.

This effect of age-strengthening at 400° F. for the melamine material was apparent from the results of step-creep tests. Six specimens loaded at various stresses between 30,000 and 33,000 p.s.i. failed instantaneously. Yet one preliminary step test at 400° F. performed on the melamine material was stressed initially at 20,000 p.s.i. and after stepping up the stresses by 2000 p.s.i. intervals over a period of 440 hr. finally failed at a stress of 38,000 p.s.i. Two other step tests at 400° F. gave similar results. These results suggest that the material increases in strength with time at this temperature. On the other hand, a "coaxing effect" resulting from starting the stressing below

Table II: Summary of computed creep data for melamine glass fabric laminate

			Rate of creep at 500 hr.							
				Computed from eq. 5			Time exponent, n			
Temperature	Stress	ϵ_{ii}, average of values from 29-sec. and 500-hr. computations	Measured[a]	Computed from eq. 3 using n_1	qAl constant	qAl varying with temperature	From 20-sec. and 500-hr. data (n_1)	From 20-sec. and 1000-hr. data (n_2)	ϵ_{ii}'	σ_{ii}
°F.	p.s.i.	%	10⁻⁷ in./in.-hr.	10⁻⁷ in./in.-hr.	10⁻⁷ in./in.-hr.	10⁻⁷ in./in.-hr.			%	p.s.i.
40	4,100	0.0618[b]	—	0.184[c]	—	—		0.0137	0.424	26,000
	8,200	0.1323[b]	—	0.395[c]	—	—				
	12,000	0.2035[b]	—	0.608[c]	—	—				
	16,400	0.2853[b]	—	0.851[c]	—	—				
77	2,400	0.0339	1.45	0.82			0.0113	0.0186	0.575	35,000
	4,800	0.0753	1.95	1.81						
	7,200	0.1182	1.78	2.84						
	9,600	0.1600	1.38	3.86						
	12,000	0.2061	1.62	4.97						
	14,400	0.2490	2.26	6.00						
	16,800	0.2938	2.52	7.20						
130	4,100	0.0692	0.79	0.43			0.0263	0.0281	0.255	15,000
	8,200	0.1479	1.58	0.92						
	12,000	0.2249	2.70	1.39						
250	7,500	0.153	2.1[d]	2.19	3.37	2.08			0.574	27,000
	15,000	0.338	6.8[d]	4.84	6.8	4.21	0.0516			
	30,000	0.771	16.8[d]	11.01	14.1	8.54				
400	10,000	0.274	43	7.16	22.1	6.5	0.0797		0.569	21,000
	26,400	0.906	53	23.7	58.5	17.4				
	29,350	1.089	54	28.5	66.5	19.4			0.479[e]	24,800[e]

[a] Values corrected for change in length of the control specimen.
[b] Computed from 20 sec. and 1000 hours.
[c] Computed values from reference 4 based on n_2 and ϵ_{ii} determined from 20 sec. and 1000 hours.
[d] The creep rate was determined between 350 and 450 hr. because of a disturbance near 500 hours.
[e] Average value.

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the creep strength and gradually increasing the stress may have produced the strengthening. No results of a similar nature were shown so distinctly in the step-creep tests on the silicone laminate.

Silicone laminate specimens of two different types (Fig. 1c, 1d) were tested at 77° F. The slight difference in fracture time may have resulted from differences in conditioning time or aging. The specimens of the type shown in Fig. 1d were conditioned in the laboratory for approximately 2 mo. before testing. The specimens of the type shown in Fig. 1c were exposed to the same conditions 11 to 18 mo. before testing.

One specimen of each type tested at the same stress of 10,500 p.s.i. failed at the centers of their gage lengths in almost the same time interval. This seems to discount the effect of aging at 77° F. The other three specimens of the type shown in Fig. 1d failed at the grip which suggests that they may have failed prematurely.

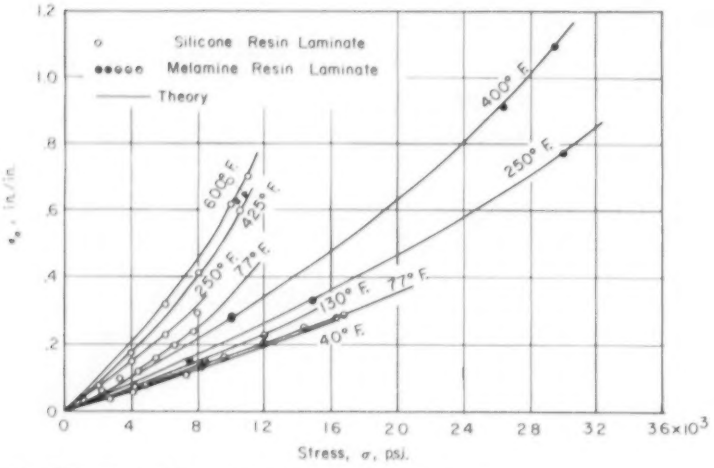

Fig. 20: Effect of stress on time-independent term ϵ_0

Conclusions

Both glass fabric laminates showed a decrease in static tensile and compressive properties with increasing temperature. At lower temperatures the melamine-glass fabric laminate showed more desirable mechanical properties than the silicone-glass fabric laminate. The melamine laminate is not suited for the high-temperature conditions in which the silicone laminate will respond favorably. The silicone laminate did not deteriorate appreciably at 600° F.

The melamine laminate demonstrated a pronounced weakening in resistance to fracture for the first few hours of exposure to the 400° F. temperature. Gradually the material seemed to strengthen and at approximately 430 hr. was able to withstand stresses ranging from 34,000 to 38,000 p.s.i.

The silicone laminate did not exhibit the initial weakening effect at high temperatures for the first few hours after loading. Instead an immediate strengthening effect was noticeable and the material showed indirect signs of continuing to strengthen with time.

The creep test data indicate that the rate of creep increases with higher temperatures for both materials. The creep test results at various temperatures seem to support the proposition that the percent increase in strain due to creep for a given time interval (creepocity) is independent of stress. This being true, creepocity may be a useful and valuable concept in comparing the creep resistance of materials.

Computations made from the creepocity values indicate that the time-exponent n is a linear function of absolute temperature and that there may be no time effect at certain predicted low temperatures on these two materials. No tests were performed at these low temperatures, however.

Some evidence is offered to support the activation energy theory. The activation energy was found to be about 1460 cal./mole for both laminates.

An equation is presented which describes the creep as a function of stress, time, and temperature.

Results of recovery data indicate that in general higher temperatures cause a decrease in recovery strain for both materials that were tested.

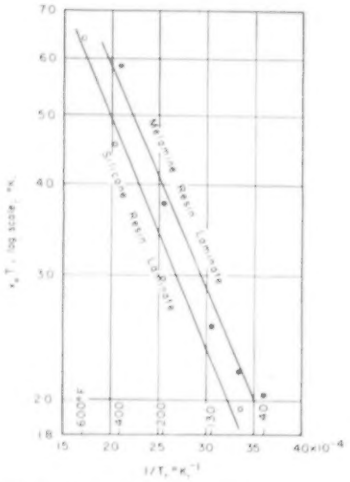

Fig. 21: Relation between $\epsilon_0 T$ and 1/T. (See Eq. 14)

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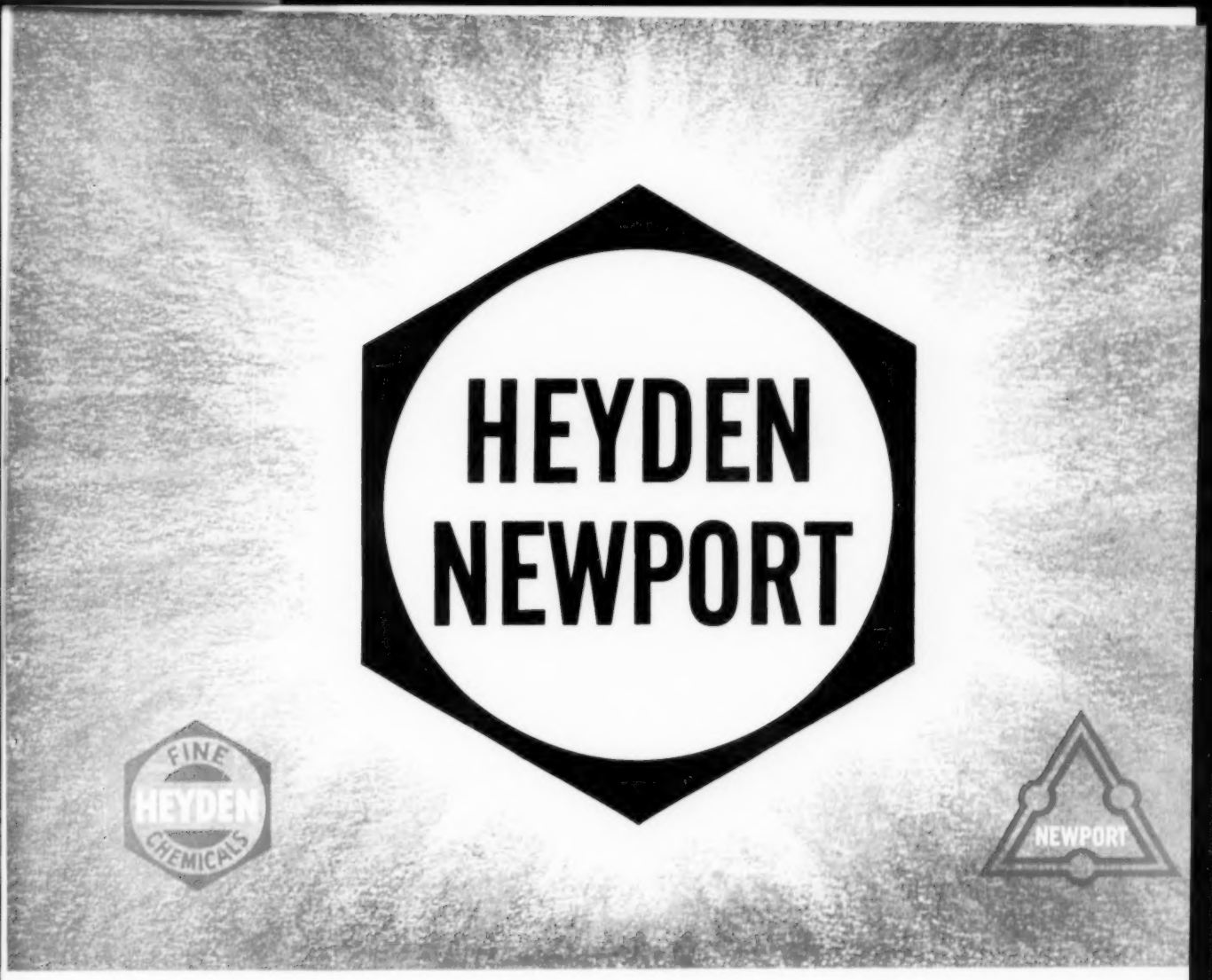

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Table III: Summary of computed creep data for silicone-glass fabric laminate

Temperature	Stress	ϵ_0, average of values from 20-sec. and 500-hr. computations	Rate of creep at 500-hr.		Time exponent n from 20-sec. and 500-hr. data	ϵ_0'	σ_0
			Measured	From eq. 3			
°F.	p.s.i.	%	10^{-3} in./in.-hr.	10^{-3} in./in.-hr.		%	p.s.i.
77	1,100	0.0284	0.6	0.19	0.0283	0.203	7,800
	2,200	0.0579	1.0	0.39			
	3,300	0.0906	1.4	0.62			
	4,400	0.1169	1.7	0.80			
	5,500	0.1555	2.3	1.06			
	6,600	0.1960	2.5	1.34			
	7,700	0.2340	3.0	1.60			
250	2,000	0.0719	2.0	1.26	0.0600	0.278	8,200
	4,000	0.1396	3.9	2.44			
	6,000	0.2230	4.9	3.9			
	8,000	0.2960	6.9	4.9			
425	4,000	0.163	4.6	2.79	0.0591	0.304	7,360
	8,000	0.413	12.0	7.07			
	10,000	0.681	14.0	11.63			
600	6,000	0.305	30.5	12.1	0.1040	0.392	8,200
	10,000	0.606	49.5	24.2			
	10,500	0.596	48.5	23.8			
	11,000	0.689	48.0	27.5			
						0.294[a]	7,900[a]

[a] Average value

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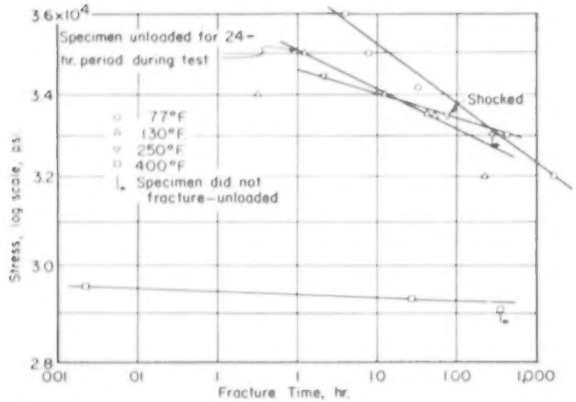

Fig. 22: Stress versus time to fracture at various temperatures for a melamine resin-glass fabric laminate

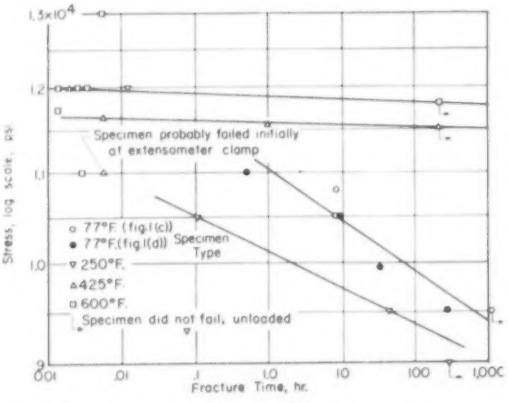

Fig. 23: Stress versus time to fracture at various temperatures for a silicone resin-glass fabric laminate

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Adhesives for vinyl film laminations

*By Sam Gold**

As new films, surfaces, and combinations are developed in rapid succession, only the larger and well equipped laboratory organizations can deal adequately with the changing scene. Thus, it appears timely to present an up-to-date review of the vinyl film lamination field, covering end uses, types of adhesives used, types of laminations made, and methods of laminating, together with a discussion of techniques for lamination and evaluations of laminations made.

End uses

Wall covering: Several types of laminations are made for wall covering. Most use a cloth backing, varying from a loose cotton cloth to a glass cloth backing. Some wall coverings include vinyl film laminated to rubber-saturated paper. The vinyl film used varies from 4 to 12 mils in thickness, usually, and may be embossed or printed film.[1]

Upholstery: End use is for automobiles and furniture. Cloth backings used range from heavy cotton drill cloths to cotton jersey. The automotive industry also uses non-woven backings for quilted effects in door panel assemblies. Heavy-gage vinyls are used (12 mils and up). This is the largest use for vinyl-cloth laminations.[2]

Tablecloths: Usually consist of thin vinyl (4 to 6 mils) laminated to a loose cotton cloth construction. The vinyl film is printed for decorative effects.

Lampshades: Usually a paper or glass cloth backing laminated to a very-low-plasticized vinyl film of medium thickness (8 to 15 mils).

Wearing apparel: Belts, shoes, and handbags with vinyl film laminated to cloth are being used. The lamination of clear or metallized Mylar to a vinyl lamination (cloth or paper backed) is used for striking decorative effects.

Luggage, wastepaper baskets, hampers, etc.: The lamination of a low-plasticized embossed vinyl film to magnesium or aluminum has received good acceptance for lightweight luggage. The vinyl film being embossed is bonded to the metal using a special technique in order not to destroy the embossed pattern. A recent new lamination has been that of clear Mylar to thin vinyl film for hampers, and wastepaper baskets. To obtain even greater decorative effects, strips of metallic yarn or metal flock are introduced between the Mylar and vinyl film in the lamination.

Furniture: Lamination of vinyl to steel or aluminum for office furniture, typewriters, etc., is a recent development and offers greater decorative effect plus the chemical protection of the vinyl film. Here, a low-plasticized flat or embossed vinyl is used.

Lamination of a low-plasticized vinyl to wood for furniture is still another recent trend. Here the vinyl is embossed, flat, or printed and sandwiched between a sheet of clear vinyl.

Types of adhesives used

Two types of adhesive systems are used: aqueous and lacquer. The aqueous adhesive systems may be based on rubber or poly-

Table I: Advantages and disadvantages of various types of laminating adhesives

Type of laminating adhesive	*Advantages*	*Disadvantages*
Rubber latex adhesive	Soft hand. Moderate bond. Good water resistance. Good low temperature flexibility.	Fair elevated-temperature bond. Tends to discolor. Fair to poor machining properties. Residual odor.
Vinyl	Good bond on cotton, cloth, and paper. Good water resistance.	Fair machining properties. Fair low-temperature flexibility. Adhesion only fair on synthetic fiber blends.
Rubber cements	Good bond. Soft hand. Good water resistance. Good low-temperature flexibility.	Flammable. Uses expensive solvents which are not recovered. Fair machining properties—usually knife coated. Color is only fair.
Vinyl lacquers	Good bond. Good water resistance. Good hand. Good color.	Flammable. Uses expensive solvents which are not recovered. Fair low-temperature flexibility.

*National Starch Products, Inc.

[1] A recent wall covering construction is the lamination of clear Mylar to vinyl laminated to cloth or rubber-saturated paper.

[2] A new lamination for automotive use consists of metallized Mylar laminated to a cloth-backed vinyl lamination.

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vinyl chloride latices. The lacquer systems may be based on rubber cements or vinyl lacquers. In both types blended adhesives of rubber and vinyl are often used to obtain the outstanding properties of each type. (See Table I, p. 206.)

Types of laminations made

1) Vinyl film to cloth (cotton drill, non-woven, nylon, Dacron, cotton), cotton knit jersey, rayon knit jersey, loose cotton scrim or muslin type, and glass cloth.

2) Vinyl to paper or paperboard (rubber-saturated papers, pulpboard, etc.).

3) Vinyl to steel, magnesium, or aluminum.

4) Vinyl to plywood, hardboard, and soft woods (e.g., pine and bass).

5) Clear or metallized Mylar to vinyl film or vinyl laminated or coated on cloth or paper. Mylar film of ½-mil thickness is used.

Methods of laminating

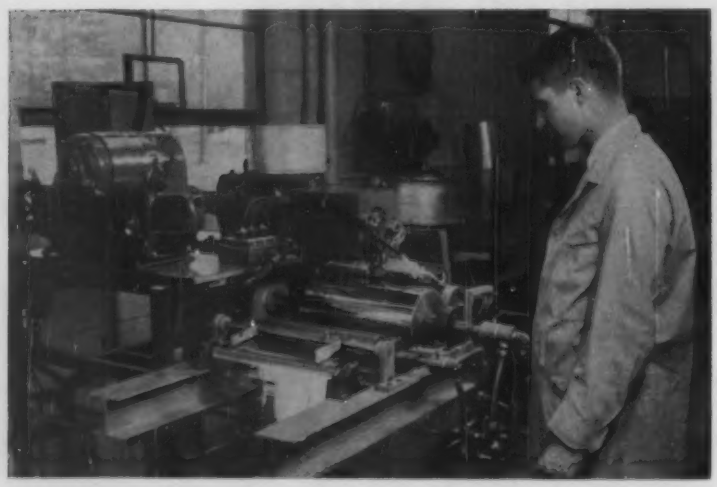
"Thermoplastic" mounting: Always used with solvent-type adhesives for bonding two impervious surfaces together, and often used in bonding vinyl to cloth or paperboard. In this method, the adhesive is applied to the metal, Mylar, or cloth, then dried in an oven to remove solvent, and lastly bonded to the vinyl using heat and pressure with a "nip" roll. Temperature of bonding is usually 275 to 350° F. with 50 to 350 p.s.i. pressure.

An exception to the above technique is used in bonding an embossed vinyl to metal. In this case the adhesive is coated on the metal and dried in an oven until the temperature of the adhesive film reaches 300 to 350° F. The embossed vinyl is immediately laminated to the metal with pressure only. In this way, a good bond is obtained without destroying the embossing pattern.

Wet combining: Most often used in lamination of vinyl to paper, paperboard, wood, and cloth. The adhesive is coated upon the cloth or paper, then immediately bonded to the vinyl with nip roll pressure. If the paper stock is quite porous, it may become necessary to drive off moisture in the lamination, using forced-air drying, infra-red drying, or even hot drying cans.

In some cases wet combining technique has been used to laminate vinyl to cloth. After the lamination is made and oven-dried to remove moisture, a hot nip roll at 275° F. or higher is used with pressure to pick up the bond strength of the lamination.

Solvent reactivation: In this method of laminating, a previously coated and dried adhesive film is moistened with a solvent to tackify the adhesive film and insure an adequate bond. This method is used where heat and/or pressure would mar the finish or embossing pattern of the vinyl used. It is also used where two sheets of vinyl film are to be laminated together.



Extrusion-coating apparatus for film laminating. (Photo, Nat'l. Starch)

Calendar lamination: In this method of combining, a previously coated and dried adhesive film on cloth is reactivated somewhat by using Liberty-type embossing preheaters, radiant glass or infra-red heating. A calendered vinyl film is then bonded to the coated cloth using high temperature with high pressure to insure minimum bond strength. Most often a calendar "nip" temperature of approximately 350° F. and pressures of several hundred p.s.i. are used to give adequate bonds. The advantage of this technique is the high production speed together with the minimum chance of migration of the adhesive used for bonding the vinyl to cloth.

Evaluation techniques

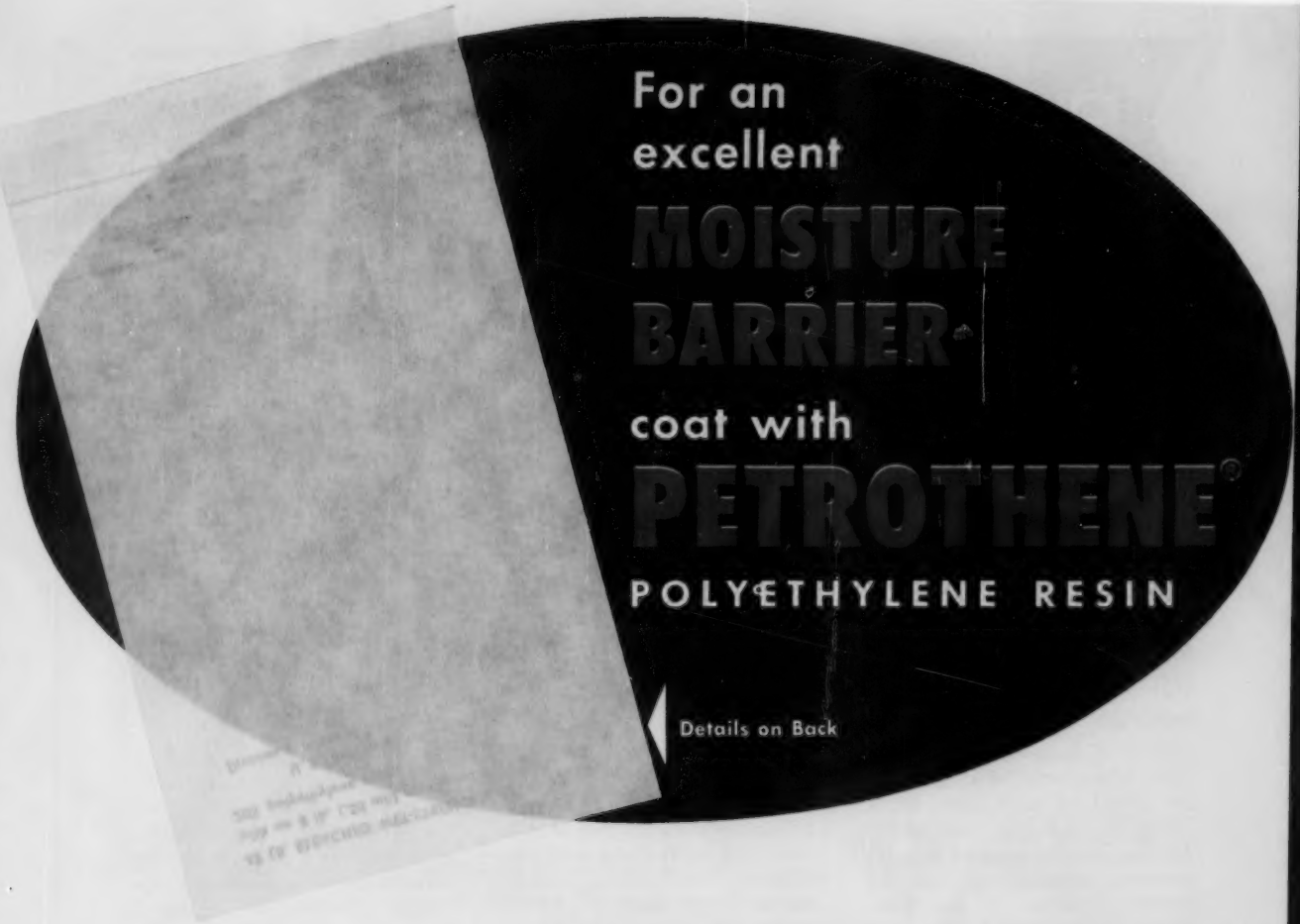
With the varied types and number of vinyl laminations it is important to have evaluation tests that the lamination must withstand if an adequate bond is to be provided under the conditions of use. Six such tests will be described.

Tensile strength: Determination of tensile strength of lamination is most important in vinyl-to-cloth, vinyl-to-metal, and vinyl-to-clear or -metallized Mylar lamination. Since the bond strength of most satisfactory adhesives used for vinyl to metallized Mylar lamination is sufficient to remove the metallized coating from the Mylar, the determination of tensile strength becomes a difficult factor for evaluation of bond in this particular lamination.

In the lamination of vinyl to cloth when a tightly woven cotton cloth backing is used quite often the bond strength will run from 6 lb./in. of width upward. With a loosely woven fabric lower bond strength of approximately 3 to 4 lb./in. of width is quite common.

Stiffness or softness of hand: Softness of a vinyl lamination is most important in lamination of vinyl to cloth for upholstery for automotive interior applications where draping effect or conformability with rounded or irregular surfaces is important. In most cases softness is evaluated by feel. Control methods of determining softness such as a Gurley Stiffness

(To page 296)



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Plastics Digest

Abstracts from the world's literature of interest to those who make or use plastics or plastic products. For complete articles, send requests direct to publishers. List of addresses is at the end of Plastics Digest.

General

Plastics. R. B. Seymour. Ind. Eng. Chem. *48*, 1760-74 (Sept. 1956). Recent developments in plastics are reviewed. 369 references are included.

Fibers. C. S. Grove, R. S. Casey, and J. L. Vodonik. Ind. Eng. Chem. *48*, 1721-30 (Sept. 1956). Recent developments in fibers are reviewed. 166 references.

Materials

Effects of foaming catalysts on aging of urethane foams. J. Winkler. SPE J. *12*, 23-25 (Nov. 1956). When the activator used in the foaming process remains in polyurethane foam, it activates the depolymerization of the foam under the influence of humidity and elevated temperatures. This study was undertaken to find an activator that could be tied into the foam structure chemically and thus inactivated. A tertiary ester amine, which is a tetra ester of diethylaminoethanol and ethylenediamine tetraacetic acid, was synthesized and used as an activator. The resulting resilient foam had superior aging properties.

High porosity polystyrene cation exchange resins. I. M. Abrams. Ind. Eng. Chem. *48*, 1469-72 (Sept. 1956). A polystyrene cation exchanger resin free of the tendency to spall and crack both during manufacture and use is described. A new type of opaque copolymer spherule accomplishes this objective. In addition, these beads were found to be considerably easier to sulfonate than the conventional ion exchange matrices. A series of the new resins made with 2,4,6,8,10,12, and 16% divinylbenzene was prepared, and the exchange capacities and water imbibition were compared with similar copolymers prepared by the conventional copolymerization method. The evidence indicates a new type of polystyrene ion exchanger in which the resin consists of a heterogeneous labyrinth of solid polymer and microchannels.

Urethane plastics—polymers of tomorrow. Ind. Eng. Chem. *48*, 1383-91 (Sept. 1956). The synthesis and properties of cellular urethane plastics are described in detail. The advantages and disadvantages of cellular rubber, cellular vinyl chloride plastics, cellular polystyrene, and cellular urethane plastics are compared. Some information on urethane resin coatings, adhesives, molding compounds, and rubbers is given. Economic information and expansion in cellular urethane plastics are also given.

Epoxy-butadiene resins. C. G. Fitzgerald, A. J. Carr, M. Maienthal, and P. J. Franklin. SPE J. *13*, 22-24, 58 (Jan. 1957). In an effort to combine the thermal and electrical properties of cross-linked polybutadiene and the low-temperature curing properties of epoxy resins in a single resin, liquid polybutadiene was epoxidized with peracetic acid in chloroform. Polymers of epoxy-oxygen content up to about 8.3% were obtained. The epoxy-polybutadiene resins were cured with a polyfunctional amine and with an anhydride of a dibasic acid. The epoxy-polybutadiene resins with an epoxy-oxygen content of about 2 to 4% either failed to cure or resulted in a friable resin; at somewhat higher epoxy-oxygen contents, the resin had good flexibility and promising dielectric properties; above 8% the cured resins were usually hard and brittle. The dielectric constant and dissipation factor of a resin containing 6.13% epoxy oxygen are presented as functions of temperature and frequency, while the volume resistivity of this same resin is shown as a function of temperature. For a flexible resin, these properties are considered good.

Effect of ratio of diisocyanate isomers in polyurethane foams. G. T. Gmitter and E. E. Gruber. SPE J. *13*, 27-30 (Jan. 1957). A series of polyurethane foams were prepared wherein the only variables were the ratio of the 2,4- to 2,6-toluene diisocyanate. Both the foam height and the foam time increased with increasing 2,4-isomer content.

A low-pressure polyethylene. R. V. Jones and R. M. McGlamery. Modern Packaging *30*, 159-62, 227, 228 (Nov. 1956). The properties of film made from high-density polyethylene produced by the Phillips process are reviewed. Compared to film made from conventional polyethylene, this film has higher strength, greater stiffness, greater abrasion resistance, improved anti-blocking characteristics, higher softening point, better chemical resistance, and lower gas and vapor permeability.

Aryl phosphate plasticizers in modern plastics processing. Plastics (London) *21*, 289-90 (Oct. 1956). The properties and present applications of aryl phosphate plasticizers in the plastics industry are reviewed. Tritolyl (tricresyl) and trixylyl phosphates are among the most widely used plasticizers for polyvinyl chloride. They impart excellent ease of processing, flame-retardance, aging characteristics, and oil resistance, have fair plasticizing efficiency and heat and light stability, and are poor with respect to low temperature properties. The deficiencies can be overcome by the use of mixtures of plasticizers. The aryl phosphates are toxic and it is con-

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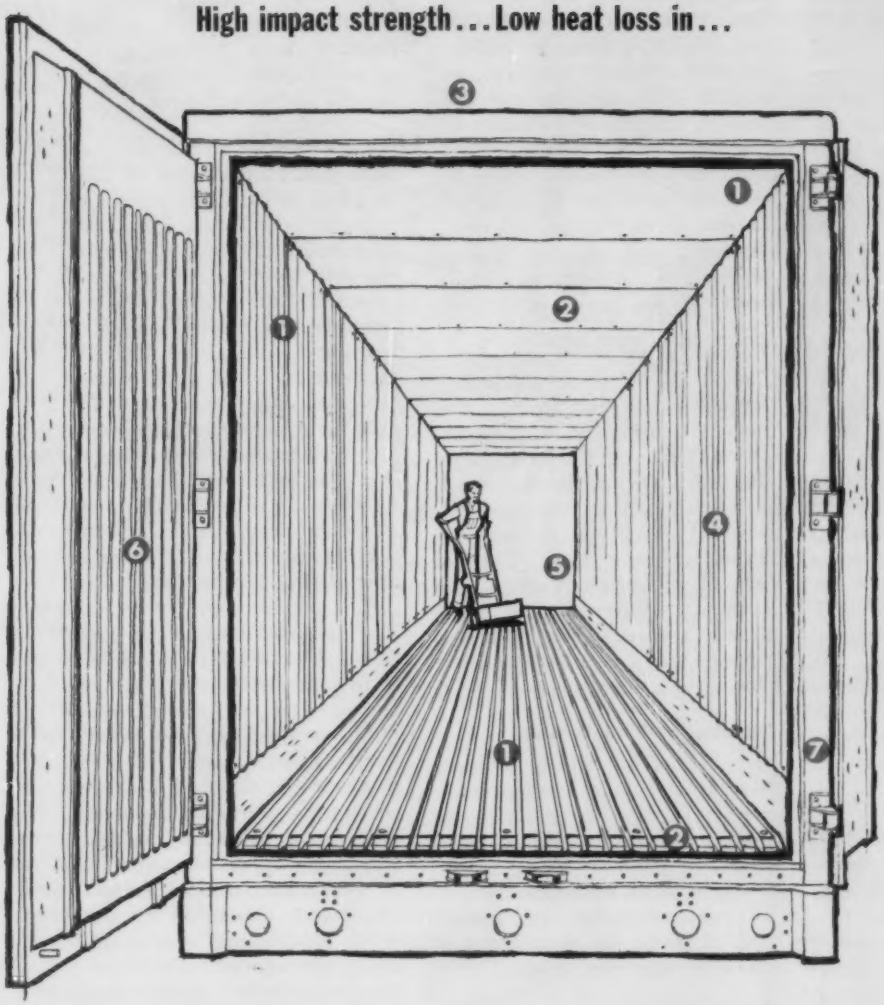
sidered inadvisable to use them

and naphthenate, are discussed.

production conditions are con-

and many others

High impact strength... Low heat loss in...



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sidered inadvisable to use them in the manufacture of goods to be used in conjunction with foodstuffs. New grades of aryl phosphates available may be used in the production of polyvinyl chloride compounds that are practically free from odor.

Pastushin "GFR" plastic process. C. Mireau. SPE J. *12*, 14-15 Dec. 1956). A semi-automatic process for producing cylindrical tanks of glass reinforced resins is described. In this GFR (glass fiber resin) process, the glass fibers and resin are automatically distributed to the surfaces of a female mold which is seated in a shroud. This distribution is controlled by a cam activated probe; centrifugal action of the shroud compresses the roving and resin. Molding pressure is applied by a vacuum bag which is inserted into the mold, and heat is supplied by integral electric heating elements. The GFR process produces tanks having higher strength properties than those having the same composition produced by matched metal molds.

Polyester laminating resins—Part 1. J. Brydson and C. W. Welch. Plastics (London) *21*, 282-85 (Oct. 1956). The chemistry of the formation of polyester resins is discussed. A mechanism of crosslinking for cold curing with a peroxide catalyst and cobalt naphthenate accelerator is proposed. The results of the investigation of the effects of catalyst, accelerator, and temperature on the curing of a polyester resin are also presented. The results show that the gel time decreases as catalyst concentration or accelerator concentration increases. Temperature was found to affect the gel time exponentially. Vanadium naphthenate was the only naphthenate examined that offered a gel time comparable to cobalt. It is believed that the cause of aging in polyesters is not oxidation but prolonged crosslinking which causes internal strain and hence premature breakdown on stressing. *Part 2.* J. Brydson. Plastics (London) *21*, 323-24 (Nov. 1956). Methods of producing gelation in polyesters, other than by using a peroxide and naphthenate, are discussed. These include light gelation, thermal gelation, gelation by benzoyl peroxide at elevated temperatures, gelation by benzoyl peroxide and amines, and use of cobalt naphthenate without peroxides. An uncured polyester resin may be evaluated from the following information: acid value, gel time, viscosity, and styrene content. Methods for determining these properties are described.

Fittings for polythene pipe. Brit. Plastics *29*, 405 (Nov. 1956). Injection-molded polyethylene fittings are described for joining polyethylene pipe. Molded into the fitting are circular resistance elements leading through the body of the fitting to two external connector wires. When a current is passed through the element, sufficient heat is produced to cause localized melting of both the pipe and the fitting, thus welding them together.

Molding and fabricating

New method for welding thermoplastics. H. Schulz. Der Plastverarbeiter *7*, 337-41 (Sept. 1956). A new machine for welding rigid polyvinyl chloride is described. The advantages and disadvantages of machine-welded vs. hand-welded seams are discussed and shown in microphotographs.

Applications

Performance factors in injection molded polythene domestic ware. A. B. Glanvill. Plastics (London) *21*, 264-66 (Oct. 1956). Factors that affect the performance of polyethylene domestic ware are discussed, including those arising from service conditions, from the natural characteristics of the material, and from production conditions. Those performance factors arising from service conditions are improper cleaning methods, staining after surface breakdown, failure and permanent distortion from heat and load, burning, cutting, splitting of the sprue, environmental cracking, delamination, and splitting of knit lines. Performance factors arising from the natural characteristics of the material are flexibility, lightness and buoyancy, color, and section thickness. Factors arising from production conditions are contaminated material, silicone cracking from release agents, ruptured ejection, packing, warping and low surface gloss.

Glass polyester reinforced concrete pipe. Brit. Plastics *29*, 298-99 (Aug. 1956). Glass-reinforced polyester resin is used for the reinforcement of centrifugally spun concrete pipes which are used extensively for drainage and for irrigation. The process consists of winding a number of helically disposed layers of glass rovings over the concrete pipe and at the same time impregnating the rovings with a cold setting formulation of polyester resin. The reinforced pipe will withstand external crushing loads and line pressures four to eight times as great as the non-reinforced pipe.

Thermoplastic pipe. B. Kellam. SPE J. *13*, 31-34 (Jan. 1957). The factors involved in the use of plastic pipe by an electrical utility are detailed. These include effect of environment, effect of temperature, electrical behavior, contamination by fluids, compatibility with cables, and installation problems. Results are given of environmental tests made in an effort to select one pipe material for all applications. Unplasticized polyvinyl chloride pipe has given the best results. However, marked variation in environmental test results were obtained on polyvinyl chloride pipe made of the same resin by different fabricators.

Coatings

Applications of infra-red spectroscopy to surface coatings. L. A. O'Neill and C. P. Cole. J. Appl. Chem. *6*, 399-407 (Sept. 1956). A survey is made of the applications of infra-red spectroscopy in the surface coatings field, especially in connection with 1) the chemistry of drying oils, 2) the curing of epoxy resins, and 3) the identification of synthetic resins.

Chemical and spectroscopic studies of epoxy resin reactions in the surface coating field. L. A. O'Neill and C. P. Cole. J. Appl. Chem. *6*, 356-64 (Aug. 1956). Esterification of epoxy resins with

fatty acids at 260° C. occurs in two stages: 1) addition of one fatty acid molecule to an epoxy group to form a hydroxy-ester and 2) esterification of the original and of the so-formed hydroxy groups. The curing process of epoxy resins with amines was studied by infra-red spectroscopy, and by measurement of the product that is non-extractable by solvents. The combined data provide some indication of the curing mechanism.

Properties

A method for evaluating low-temperature shock resistance. L. S. Buchoff. SPE J. *12*, 34-35, 52 (Aug. 1956). The low-temperature shock resistance of plastics can be evaluated by embedding fine copper wires in the composition, following the temperature changes in the mass by recording the change in resistance, and determining the temperature at which the plastics cracks from the rupture of the fine wires.

Arc resistance: radio-frequency corona resistance. M. Olyphant, Jr. A.S.T.M. Bulletin No. 216, 47-55 (Sept. 1956). At radio frequencies, surface-corona discharges can occur around conductors in contact with insulating materials at voltages considerably below those required to produce 60-cycle arcing. Such discharges differ markedly from low-frequency phenomena in their characteristics and effects on insulation. Equipment developed for producing and metering 3-mc. corona discharges is described. The resistance of a variety of thermosetting materials to corona discharges was studied by determining tracking times at various current and power levels. These observations reveal interesting differences from low-frequency behavior. However, it was also found that power levels producing failure in a given time are of the same order with either 3-mc. corona, 60-cycle arcs, or d.-c. high-current pulses. This finding indicates that failure is principally dependent on the heat input to the specimen. The conclusion is reached that the most rewarding fields for further investigation lie in the study of the effects of much lower and higher power phenomena. Also reported are the results of corona starting voltage tests which reveal that this voltage is principally dependent upon, and can vary over a considerable range with, changes in dielectric constant.

Corona properties of insulating materials. W. T. Starr. Elec. Mfg. *57*, 132-39 (June 1956). The results of an investigation of the corona properties of some 27 materials, organic and inorganic, under various conditions of temperature, humidity, and immersion are reported. Corona effects are critical in the survival of insulation. Effective corona tests provide a valuable tool in the selection, specification, and use of optimum materials for particular applications. Design interpretation as well as detailed test results are given. Voids and flaws in materials constitute a serious cause of premature failure in materials that have basically high corona resistance; hence, process control in the manufacture of high-insulation materials is of great importance.

Weight and length changes in specimens made of amino plastics. E. Gwinner. Kunststoffe *46*, 467-71 (Oct. 1956). Dimensional changes upon aging in amino plastics are of great importance. Thermosetting specimens with varying amounts of resin and filler were tested under various extreme conditions such as dry heat, after water immersion, and after 2-years' storage at room temperature. The latter conditions produced irregular although parallel weight variations. The absolute values of these changes depend on the composition of the mixture and on the preheating temperature. The specimens were 4 and 10 mm. long. Correlation of the data to specimens of other dimensions is not possible.

Water absorption of thermoplastics. W. Eulitz. Kunststoffe *46*, 403-07 (Sept. 1956). The difference in water absorption or swelling of injection molded plastics is of great practical importance. The mathematical interrelationship of the swelling process was investi-

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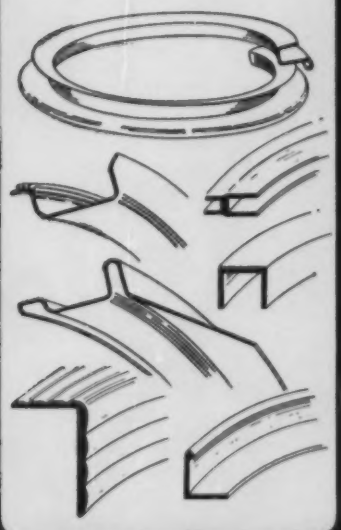

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gated. A mathematical formula was developed for the "relative" surface area which shows that the resistance of a thermoplastic to water resistance can be expressed by a material constant.

Investigation of the impact strength of polystyrene. H. Högberg. Kunststoffe *46*, 350-58 (Aug. 1956). Comparative Charpy impact tests were made on specimens consisting of four different kinds of polystyrene. The specimens were either injection or compression molded under varying conditions of molding. The tests revealed the optimum molding conditions for obtaining isotropic specimens having uniform properties. The impact strength test methods are discussed. Two kinds of specimens, one injection molded in the lengthwise direction and the other in the transverse direction, give a better picture of the impact strength of polystyrene and the mechanical anisotropy than the usual injection-molded specimens.

An equation for tension creep of three unfilled thermoplastics. W. N. Findley and G. Khosla. SPE J. *12*, 20-25 (Dec. 1956). Results of creep tests of polyethylene, polychlorotrifluoroethylene, and rigid polyvinyl chloride are reported. Each material was loaded in tension creep at several different values of stress. Creep tests were performed at a temperature of 77° F and a relative humidity of 50%. Creep strains observed in these tests were compared with those obtained theoretically by assuming a creep equation of the form:

$$\varepsilon = \varepsilon_0 + mt^n$$

where ε = shear strain at time t, ε_0 = instantaneous shear strain, and m and n are constants of the material. It is shown that the experimental creep curves are very well described by the above creep equation.

Improved procedure for measuring tensile modulus and its use in studying the modulus-density relationship for polyethylene resins. C. H. Adams and R. H. Supnik. A.S.T.M. Bulletin No. 217, 70-74 (Oct. 1956). The standard A.S.T.M. procedure for measur-

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ing the tensile modules of plastics films (D 882) was modified and used to measure the moduli of polyethylenes of various densities. The modulus of polyethylene films increases during the first few days after molding. The modulus values were found to be a linear function of density.

Testing

Colorimetric determination of phenolic resins. M. H. Swann and D. J. Weil. Analytical Chem. *28*, 1463-65 (Sept. 1956). A modification of the nitrous acid test for free phenols is presented for phenol-aldehyde resins in varnishes and other coatings. An intense yellow color is developed with phenolic resins; the color is specific and can be used for quantitative measurement if the nature of the raw materials is known. The phenolic content of resins of unknown origin can be estimated by this method.

Measuring the effect of plasticized vinyls on impact polystyrene. R. R. Dixon. SPE J. *12*, 17-18, 40 (Oct. 1956). A test is described that was developed to evaluate the physical deterioration of impact polystyrene in contact with plasticized polyvinyl chloride. The test consists of measuring the flexural strength of the polystyrene after it has been stressed while in contact with the vinyl plastic. The evaluation of variables associated with this test is described.

Publishers' addresses

Analytical Chemistry: American Chemical Society, 1155 Sixteenth St., N. W. Washington 6, D. C.

A.S.T.M. Bulletins: American Society for Testing Materials, 1916 Race St., Philadelphia, Pa.

British Plastics: Iliffe and Sons, Ltd., Dorset House, Stamford St., London S. E. 1, England.

Der Plastverarbeiter Wieslautenstr. 49 Landau/Pfalz, Germany.

Electrical Manufacturing: The Gage Publishing Co., 1250 Sixth Ave., New York, N. Y.

Industrial and Engineering Chemistry: American Chemical Society, 1155 Sixteenth St., N. W. Washington 6, D. C.

Journal of Applied Chemistry: Society of Chemical Industry, 56 Victoria St., London S. W. 1, England.

Kunststoffe: Karl Hanser Verlag, Leonhard-Eck-Strasse 7, Munich 27, Germany.

Modern Packaging: Modern Packaging Corp., 575 Madison Ave., New York 22, N. Y.

Plastics (London): Temple Press Ltd., Bowling Greene Lane, London E. C. 1, England.

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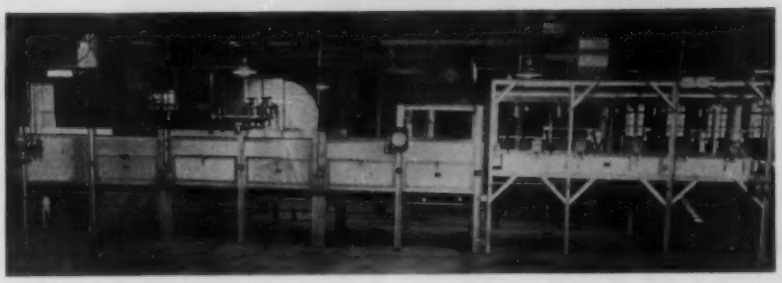

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Copolymers. G. E. Ham (to Chemstrand). U. S. 2,769,801, Nov. 6. Copolymers of acrylonitrile and aminoesters of itaconic acid.

Polymers. J. E. Pritchard (to Phillips Petroleum). U. S. 2,769,802, Nov. 6. Polymers of divinyl sulfide.

Copolymers. W. Becker (to Farbenfabriken Bayer). U. S. 2,769,803, Nov. 6. Copolymers of vinylchloride and 1,1-dichloro-ethene.

Polymers. A. W. Hanson (to Dow). U. S. 2,769,804, Nov. 6. Continuous polymerization of vinylidene compounds.

Molding. G. W. Kelly (to Columbus Plastics). U. S. 2,770,011, Nov. 13. Dies for injection molding.

Resins. C. S. Lynch (to Phillips Petroleum). U. S. 2,770,603, Nov. 13. Reacting diolefin polymers with sulfur dioxide.

Solutions. F. J. Honn and W. O. Teeters (to M. W. Kellogg). U. S. 2,770,605-6, Nov. 13. Solutions of copolymers of a perfluorochloroethylene and a fluoroethylene.

Resins. H. J. Hagemeyer and E. L. Oglesby (to Eastman Kodak). U. S. 2,770,607, Nov. 13. Copolymers of acrylonitrile with an interpolymer of an alkenol and another unsaturated monomer.

Polyethylene. H. C. Barker, E. F. Lewis, and W. B. Happoldt, Jr. (to Du Pont). U. S. 2,770,608-9, Nov. 13. Polyethylene-oleamide composition.

Stabilizers. S. Nitzsche and R. Riedle (to Wacker Chemie). U. S. 2,770,611, Nov. 13. Halogenated polymers stabilized by a hexaorganodistannoxane.

Polyesters. C. S. Schollenberger (to B. F. Goodrich). U. S. 2,770,612, Nov. 13. Diisocyanate-modified polyesters.

Resins. B. R. Tegge and F. W. Banes (to Esso). U. S. 2,770,613, Nov. 13. Petroleum resins.

Polymerization. T. H. Howarth, J. Downing, and J. G. N. Drewitt (to British Celanese). U. S. 2,770,614, Nov. 13. Polymerizing petroleum fractions containing beta-methylstyrene.

Copolymer. C. O. Kroncke. Jr. (to M. W. Kellogg). U. S. 2,770,615, Nov. 13. Copolymer of trifluorochloroethylene and vinylidene chloride.

Polymerization. L. H. Corn (to Gulf Oil). U. S. 2,770,665, Nov. 13. Preparing a propylene tetramer.

Conveyor. M. Mooney (to U. S. Rubber). U. S. 2,767,432, Oct. 23. Apparatus for conveying extruded stock.

Film. F. P. Alles (to Du Pont). U. S. 2,767,435, Oct. 23. Stretching polymeric film.

Sponge. R. L. Noland and V. M. Sanders (to V. M. Sanders and H. J. Beck). U. S. 2,767,436, Oct. 23. Forming smooth surfaces on plastic sponge.

Heat sealing. V. H. Hasselquist (to Goodrich). U. S. 2,767,769, Oct. 23. Heat sealing thermoplastics.

Automobile top. R. K. Landen (to Glas-Laminates). U. S. 2,768,023, Oct. 23. Plastic automobile top.

Leather treatment. J. S. Kirk (to General Dyestuff). U. S. 2,768,056, Oct. 23. Impregnating leather with methyl vinyl ether-maleic anhydride copolymer.

Photographic element. D. D. Reynolds and W. D. Kenyon (to Eastman Kodak). U. S. 2,768,078, Oct. 23. Reaction products of polyvinylsulfonates with C-amino pyridines.

Polyamide resin. H. Wittcoff and M. M. Renfrew (to General Mills). U. S. 2,768,090, Oct. 23. Polyamide resin suspensoids with reversed charges.

Die. M. O. Longstreth and J. E. Tollar (to Dow). U. S. 2,769,200, Nov. 6. Radial extrusion die.

Extrusion. Z. Lorenian. U. S. 2,769,-201, Nov. 6. Extrusion apparatus for thermosetting resins.

Fabric treatment. T. Boyd (to Monsanto). U. S. 2,769,732, Nov. 6. Treating fabrics with titanium polymers.

Insulating. R. G. Flowers and G. D. Holmberg (to General Electric). U. S. 2,769,739, Nov. 6. Shellac-ethoxyline resin compositions.

Surfacing. C. H. Helbing (to Pittsburgh Plate Glass). U. S. 2,769,742, Nov. 6. Surfacing polyester resin with melamine resin.

Polymerization. G. H. Birum and R. J. Kern (to Monsanto). U. S. 2,769,777, Nov. 6. Initiating photopolymerization with a photosensitive compound.

Polymers. M. M. Szwarc, A. N. Roper, and H. M. E. Steiner (to M. W. Kellogg). U. S. 2,769,786, Nov. 6. Flake polymers from aromatic compounds.

Resin. G. E. Ham (to Chemstrand). U. S. 2,769,791-2-3, Nov. 6. Composition of N-nitrosopiperidine and an acrylonitrile copolymer.

Resin. T. J. Suen and Y. Jen (to American Cyanamid). U. S. 2,769,796-7-9-800, Nov. 6. Melamine-formaldehyde-polyamine condensate.

Resins. H. Meis, W. Scheib, and K. Decker (to Rutgerswerke). U. S. 2,769,798, Nov. 6. Aminoplast resins stabilized with oxirane compounds.

Polymerization. C. E. Schildknecht and M. L. Wallace (to Celanese). U. S. 2,768,148, Oct. 23. Solution polymerization of acrylonitrile.

Resins. F. J. Zukas (to Westinghouse). U. S. 2,768,992, Oct. 30. Resinous epoxides and a bentonite-amine reaction product.

Film. R. N. MacDonald (to Du Pont). U. S. 2,768,994, Oct. 30. Polyoxymethylene film.

Acrylonitrile. P. Mosse (to Crylor). U. S. 2,768,995, Oct. 30. Treating polyacrylonitrile with formaldehyde.

Adhesives. H. W. Coover, Jr. (to Eastman Kodak). U. S. 2,768,109, Oct. 23. Alcohol-catalyzed alpha-cyanoacrylate adhesives.

Resins. H. Meis and H. Saner (to Rutgerswerke). U. S. 2,768,147, Oct. 23. Aromatic vinyl-acenaphthene copolymer.

Molding. L. P. Biefeld and R. F. Shannen (to Owens-Corning). U. S. 2,770,840, Nov. 20. Molded product made of melamine resin and gypsum.

Molding. O. M. Hahn and R. S. Mallouk (to Du Pont). U. S. 2,770,-842, Nov. 20. Injection molding of polytetrafluoroethylene.

Resin. D. M. Gagarine and H. Re-

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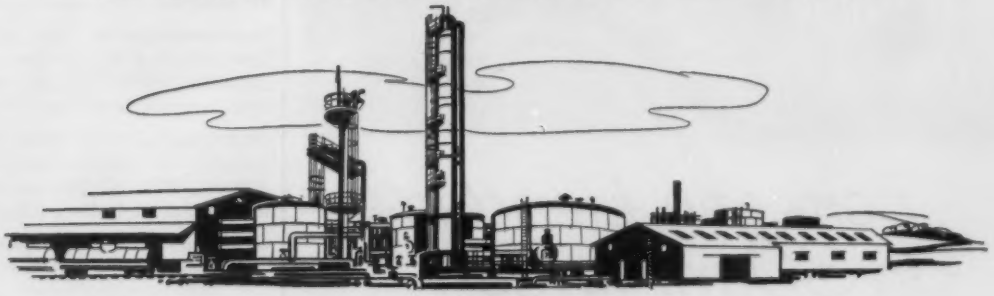

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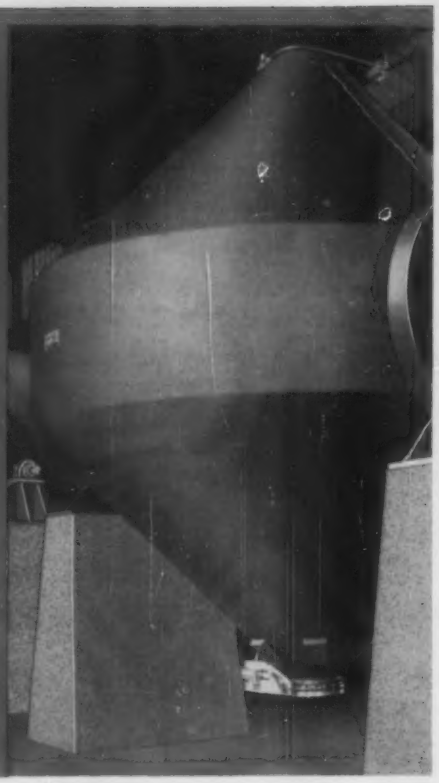

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pokis (to Dan River). U. S. 2,771,337, Nov. 20. Acrolein-formaldehyde resins.

Cellulose fibers. V. J. Moser and S. Melamed (to Rohm and Haas). U. S. 2,771,362, Nov. 20. Cellulose fibers containing polymers of vinyloxyethylurea.

Cellulose ethers. G. K. Greminger, Jr. and M. A. Weaver (to Dow). U. S. 2,771,377, Nov. 20. Compositions of water-soluble cellulose ethers.

Surface treatment. T. J. Motler (to Libbey-Owens-Ford). U. S. 2,771,378, Nov. 20. Treating polymethyl methacrylate surfaces with silicon tetrachloride.

Laminating. J. F. Rocky and F. R. Nissel (to Carbide and Carbon). U. S. 2,771,388, Nov. 20. Laminating thermoplastic foil.

Coatings. M. Konigsberg and F. Camps-Campins (to Jam). U. S. 2,771,456, Nov. 20. Coatings of butadiene-acrylonitrile copolymers.

Polymers. A. W. Barnes, B. S. Dyer, and A. A. Gibson (to Imperial Chemical). U. S. 2,771,457, Nov. 20. Vinyl chloride polymers.

Copolymers. F. W. Banes and E. Arundale (to Esso Research). U. S. 2,771,459, Nov. 20. Cationic derivatives of itaconate-diene copolymers.

Copolymers. H. H. Weinstack, Jr. (to Allied Chemical). U. S. 2,771,461, Nov. 20. Copolymerizing acrylonitrile and acrylate esters.

Polymers. K. T. Shen (to Petrolite). U. S. 2,771,462, Nov. 20. N-substituted polyvinyl heterocyclics.

Extrusion. E. H. Hankey (to Monsanto). U. S. 2,770,836, Nov. 20. Pressure head for extruders.

Extrusion. H. Reifenhauser (to Hugo Stinnes). U. S. 2,770,837, Nov. 20. Extrusion press.

Extrusion. W. W. McIntosh, J. Moziek, and O. L. Smith (to Monsanto). U S. 2,771,636, Nov. 27. Extrusion of thermoplastics.

Extrusion composition. M. Salo and O. W. Kaul (to Eastman Kodak). U. S. 2,771,638, Nov. 27. Cellulose acetate butyrate extrusion composition.

Bobbin. L. Galbreath. U. S. 2,771,849, Nov. 27. Bobbin made of vinyl plastic for rotary domestic sewing machines.

Container. R. B. Seymour (to Atlas Mineral Products). U. S. 2,771,985, Nov. 27. Plastic-lined container for corrosive liquids.

Floor covering. L. H. Dunlap (to

Armstrong Cork). U. S. 2,772,141, Nov. 27. Vinyl plastic floor tile.

Light sensitive resin. S. B. Elliott (to Ferro). U. S. 2,772,158-9, Nov. 27. Photosensitive resin.

Coated web. S. C. Rogers and K. J. Harwood (to Kimberly-Clark). U. S. 2,772,181, Nov. 27. Web coated with polyvinyl chloride resin.

Polymers. W. A. Reeves and J. D. Guthrie (to U. S.). U. S. 2,772,188, Nov. 27. Ammonia-insolubilized methylol-phosphorus polymers.

Plastisols. J. C. Fisher and L. P. Dosmann (to U. S. Rubber). U. S. 2,772,194, Nov. 27. Applying a vinyl plastisol to cured cellular rubber.

Cellular resins. E. Simon, F. W. Thomas, and W. R. Burney, Jr. (to Lockheed). U. S. 2,772,245-6, Nov. 27. Cellular resin products.

Adhesive. G. O. Schroeder (to American Can). U. S. 2,772,247, Nov. 27. Polyethylene-polyvinyl ether adhesive.

Resins. E. R. Lieberman and H. Yuska (to Interchemical). U. S. 2,772,248, Nov. 27. Water-soluble epoxy-amine resins.

Polyacrylonitrile. R. J. Slocombe (to Monsanto). U. S. 2,772,250, Nov. 27. Polyacrylonitrile stabilized with salts of vinyl sulfonic acid.

Acrylic polymers. J. E. Hansen and T. J. Dietz (to U. S.). U. S. 2,772,251, Nov. 27. Vulcanizing polyacrylic acid with a polyalkylene polyamine.

Terpolymers. J. Briskin and E. C. Chapin (to Monsanto). U. S. 2,772,252, Nov. 27. Terpolymers of styrene, acrylonitrile, and acrylic acid.

Catalysts. H. J. Hagemeyer, Jr. (to Eastman Kodak). U. S. 2,772,259, Nov. 27. Alkali hydroperoxides as olefin polymerization catalysts.

Plastic. L. A. Burrows and W. E. Jordan (to Du Pont). U. S. 2,772,444, Dec. 4. Composition of a polyhalogenated ethylene polymer and viscose.

Bonded mica. W. Schneider and A. W. Worthington (to Westinghouse). U. S. 2,772,696, Dec. 4. Flexible resin-bonded mica members.

Reinforced sheet. E. E. Magnuson. U. S. 2,772,718, Dec. 4. Reinforced continuous plastic film.

Bearings. O. Schubert, Sr. and O. Schubert, Jr. U. S. 2,772,930, Dec. 4. Bearing including a surface of hard thermosetting resin.

Printing plates. C. E. Herrick, Jr.,

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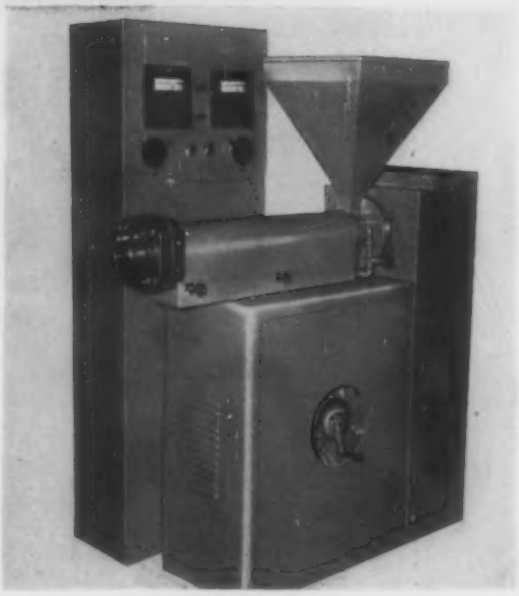

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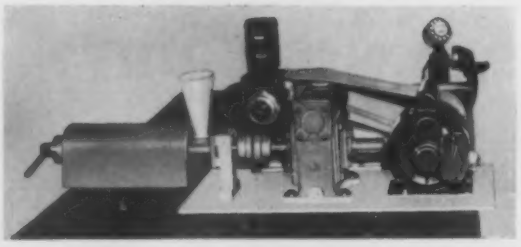

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P. T. Woitach, Jr., and E. J. Trojnar (to General Aniline). U. S. 2,772,-972, Dec. 4. Three-layer plate capable of conversion to an offset printing plate.

Sheet. E. E. Magnuson. U. S. 2,772,-993, Dec. 4. Reinforced laminated sheet.

Resin. A. H. Gleason and J. F. Nelson (to Esso). U. S. 2,772,254, Nov. 27. Solid copolymer of butadiene and styrene.

Polymerization. J. L. Ernst and H. J. Rose (to Esso). U. S. 2,772,255, Nov. 27. Copolymerizing an isoolefin with a diolefin.

Polymerization. M. A. Manganelli (to Monsanto). U. S. 2,772,256-7-8, Nov. 27. Polymerization of vinyl chloride.

Resins. F. J. Zukas (to Westinghouse). U. S. 2,773,043, Dec. 4. Compositions of epoxide resins and polyvinyl resins.

Plastics. V. C. Vesce (to B. F. Goodrich). U. S. 2,773,044, Dec. 4. Pigmented plastics.

Sheet. L. E. Simerl, A. M. Heald, and G. P. Mueller (to Marathon). U. S. 2,773,045, Dec. 4. Heat-sealable sheet coated with polyethylene.

Vinyl resins. J. H. Dunn and P. E. Weimer (to Ethyl). U. S. 2,773,046, Dec. 4. Vinyl resin plasticized with a polyhalophenyl phosphate.

Resin. J. L. Formo, L. H. LeGault, L. L. Bolstad, and A. D. Sinning (to Minneapolis Honeywell). U. S. 2,-773,048, Dec. 4. Epoxy resin containing p, p'-diaminodiphenylmethane.

Color inhibitor. M. Cowee (to Pittsburgh Plate Glass). U. S. 2,773,-049, Dec. 4. Salicylic acid esters as color inhibitors for polyester resins.

Vapor barrier. J. R. Caldwell and R. Gilkey (to Eastman Kodak). U. S. 2,773,050, Dec. 4. Articles coated with a polyacrylic ester-polyvinyl alcohol composition.

Resins. R. F. Leary (to Esso). U. S. 2,773,051, Dec. 4. Resins from cyclopentadiene monomers.

Copolymers. L. S. Cohen, A. P. Giraitis, and J. R. Zietz, Jr. (to Ethyl). U. S. 2,773,052, Dec. 4. Copolymers of propenylbenzene.

Polymerization. E. Field and M. Feller (to Standard Oil). U. S. 2,-773,053, Dec. 4. Polymerization of ethylene.

Fibrous structure. E. A. Rodman (to Du Pont). U. S. 2,773,781, Dec. 11. Polytetrafluoroethylene filaments impregnated with a copolymer of

tetrafluoroethylene and hexafluoropropylene.

Laminate. J. K. Magrane and W. S. Sloatman, Jr. (to American Cyanamid). U. S. 2,773,788, Dec. 11. Thermosetting laminate.

Garment. C. P. McIver (to U. S.). U. S. 2,773,791, Dec. 11. Resin-bonded body armor structure.

Laminate. R. J. Nebesar (to Universal Moulded Products). U. S. 2,773,792, Dec. 11. Cellular plastic incorporated in a laminate.

Resins. G. L. Fraser and C. Elmer (to Monsanto). U. S. 2,773,793-4, Dec. 11. Modified melamine resins.

Resins. R. Lindenfelser (to American Cyanamid). U. S. 2,773,848, Dec. 11. Amidogen-formaldehyde resins.

Tile. L. L. Tolman (to Armstrong Cork). U. S. 2,773,851, Dec. 11. Vinyl plastic tile.

Plastics. R. G. Rowe and G. Flower Jr. (to Dictaphone). U. S. 2,773,852 Dec. 11. Anti-static plastics.

Lacquers. A. Weihe (to Herbig-Haarhaus). U. S. 2,773,853, Dec. 11 Lacquers from a dimethylol derivative of a diurethane.

Decorative compositions. J. Hochberg and S. A. Pellerano (to Allied Chemical). U. S. 2,773,855 Dec. 11. Butyl-isobutyl methacrylate copolymer compositions.

Containers. T. E. Piazze and T. R. Baxter (to Continental Can). U. S. 2,773,285, Dec. 11. Sterile containers.

Sheet. J. A. Piccard and B. Graham (to Du Pont). U. S. 2,773,286. Dec. 11. Non-woven leatherlike thermoplastic sheet.

Pipe. W. H. Stout. U. S. 2,773,287, Dec. 11. Fibrous glass reinforced plastic pipe.

Container. A. W. Knieriem and L. C. Folst (to Calresin). U. S. 2,773.624. Dec. 11. Molded container for transporting packaged milk.

Molding. G. W. Kelly (to Columbus Plastics). U. S. 2,773.284. Dec. 11 Die construction for injection molding.

Thread. G. H. Lacy (to Dobeckmun). U. S. 2,772,994, Dec. 4. Thread made of laminated metal foil and thermoplastic resin.

Leather substitute. J. D. C. Wilson (to Du Pont). U. S. 2,772,995, Dec. 4. Supported plastic film.

Adhesives. R. H. Sams (to Philadelphia Quartz). U. S. 2,772,996, Dec. 4. Borated silicate-starch adhesives for fiberboard.

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New Machinery and Equipment*

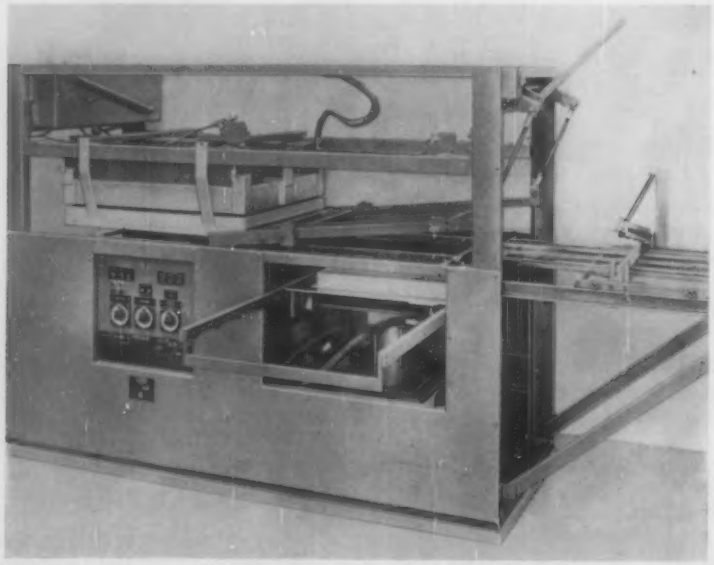
Packaging machine

The Auto-Pak vacuum forming machine is especially designed for skin packaging, blister packaging, and for "snap-pak," a type of package that snaps into a die-cut cardboard mount. It can also form low-profile items up to 5 in. deep from sheet ranging in thickness from 2 to 125 mils. Typical production rates range from 35 cast vinyl hardware skin packages to 400 acetate lipstick blister packs per minute. Heater current is 21 amp. at 220 v. (3-phase), while about 4 c.f.m. of air at 45 to 80 p.s.i. are needed to operate the machine. Heater travel, draping, timing, and shearing of formed section from web are all done automatically. A power-driven loading table is a great convenience in making blister packages and in mounting new molds. Safety features include interlocking of heater travel with positioning of loading table and locking of clamping frame, accurate control of heat, and manual operation for testing the various phases of the cycle. Platen size is 20 by 25 inches. *The Auto-Vac Co., 1984 State St. Ext., Bridgeport, Conn.*

*Specifications and claims made and appearing in these pages are those of the manufacturers of the machinery and equipment described and are not guaranteed by MODERN PLASTICS.

Scrap granulator

The Model G-200 scrap granulator is an all-steel cutter that grinds all thermoplastics, including vinyl and polyethylene, without fluffing, at rates up to 250 lb. per hour. The one-piece rotor is ball-bearing mounted, equipped with alloy-steel knives, and turned by a 1.5-hp. motor at 1200 r.p.m. The hopper chute is hinged and the entire hopper can be removed in a few seconds to facilitate cleaning. The hopper throat opening is 6.5 by 7 inches; over-all dimensions of the granulator are 33 in. long by 16 in. wide by 48 in. high. *The Van Dorn Iron Works Co., 2685 E. 79th St., Cleveland 4, Ohio*



Auto-Pak vacuum forming machine for skin packaging can form low-profile items up to 5 in. deep from 2- to 125-mil sheet

Pump for high-pressure systems

A constant-displacement pump, designed for heavy duty, can deliver from 1 to 5 g.p.m. at pressures from 3000 to 5000 p.s.i., depending on the power and speed of the driving motor. Required motor horsepower ranges from 3 to 10. The pump is well suited for use in injection molding machines, calender hold-downs, presses, etc. A complete range of mountings are available for the pump, which operates with a patented axial rolling piston design. It is recommended that the pump be equipped with a type HG micronic filter that protects both it and other equipment in the hydraulic system. *The Oilgear Co., 1560 W. Pierce St., Milwaukee 4, Wis.*

Nozzle kit for molding nylon

The kit includes a long, reverse-taper nozzle, designed according to Du Pont specifications, along with a Wheelco proportioning pyrometer, two IMS high-wattage heater bands, a 12-in. bendable, armored thermocouple, 25 ft. of I.C. thermocouple lead wire, and nozzle screens. The thermocouple gives extra service because it can be bent to clear any interference. The nylon nozzle (designed for type 66 nylon only) is adaptable to every make and model of injection machine. *Injection Molders Supply Co., 3514 Lee Rd., Cleveland 20, Ohio*

Slitter for sheets of formed products

One of the problems connected with sheet forming is the cutting apart of the many individual formings made on a multiple mold. A new right-angle slitter accomplishes this job quickly and neatly. The blades of the slitter are adjusted to the required spacing. A guide on the movable feed table positions the sheet, after which it is cut first in one direction, then in the other. Up to 30 cuts in each direction, spaced as

Van Dorn

MODEL H-250 PRESS 2½ OZ.

is FAST!

Up to 1200 cycles per hour (dry run)

AUTOMATIC!

One operator can run 3 or more presses, for greater flexibility, and lower labor costs. Selective control permits semi-automatic operation.

EASILY OPERATED!

by semi-skilled help. With simple, handy controls, job can be set up in 20 minutes.

VERSATILE!

The sketches list only a few of the many thermoplastics molded on Van Dorns.

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Polystyrene Containers — over 720 per hour

Vinyl Cord Sets —over 2000 per hour

Nylon Coil Forms — over 2000 per hour

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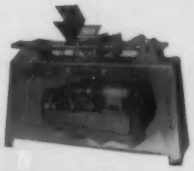
SEMI-AUTOMATIC PRESS 2-oz. capacity.



POWER OPERATED, LEVER CONTROLLED PRESSES 2-oz. and 1-oz. models.

WRITE FOR complete data on model H-250 and other equipment shown.

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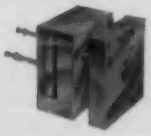
PLASTIC GRINDER Grinds up rejects, waste, etc., for re-use.



MOLD BASES Available from stock.

THE VAN DORN IRON WORKS CO., 2685 EAST 79th ST. • CLEVELAND 4, OHIO

closely as an inch apart, can be made quickly enough that the forming machine operator can handle the slitter operation, too. Made in two sizes for 30 by 30-in. and 40 by 40-in. sheets. *Abbott Plastic Machine Corp., 7124 N. Clark St., Chicago 26, Ill.*

Flexible radiant heating mats

When strip and rod radiant heaters are too narrow to do the job, a new radiant heater mat may be what is needed. Available in widths from 12 to 42 in., the mat can be woven to whatever length needed. Watt densities in excess of 8 w./sq. in. are possible, and local variations in density can be woven-in if desired. Being flexible, the mats can be shaped to almost any desired curve. *Zack Industries, 185 Goffle Rd., Hawthorne, N. J.*

Faster metallizer

The vacuum pumping system of the Model 427 72-in. vacuum metallizer has been redesigned. It now has two 16-in. "Ring-Jet" diffusion pumps plus a 6-in. booster pump; these pumps have reduced the time needed to pump down to 0.5 micron to 6 min. or less The new pumping system is also better able to handle unusual operating conditions, e.g., heavy outgassing from the work or from contaminated chamber walls. The automation features of the older model have been included. *F. J. Stokes Corp., 5500 Tabor Rd., Philadelphia 20, Pa.*

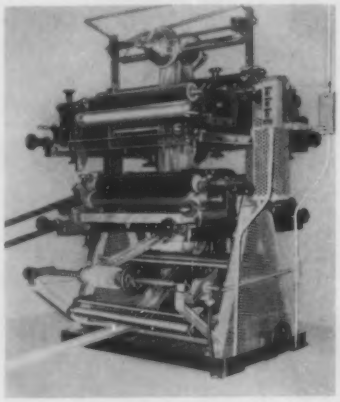
In-line preplasticator is simple, purges easily

The Peco 30M injection machine has been fitted with a preplasticator that embodies a new principle of preplasticator design The new 30MP40 has a shot capacity of 8 oz. of polystyrene, a plasticating capacity of about 90 lb./hr., and a top clamping force of 168 tons. Minimum dry cycle time is 9.9 sec. and it can handle molds up to 15.5 by 14 in. in thicknesses ranging from 6 to 12.75 inches.

The preplasticator is coaxial with the heating cylinder, the nozzle of which acts as the plunger for the preplasticator. Injection pressures on the hot melt up to 9800 p.s.i. can be obtained. Top injection rate is 13.6 cu. in./sec. Heaters are rated at 10.2 kw., the motor at 15 horsepower. *Peco Machinery Sales, Ltd., 28 Victoria St., London, S.W.I., England.*

High-speed printing units for polyethylene

Designed specifically for fast printing on polyethylene, a new line of flexographic printing presses is available for use with one to four colors. The standard



Lee flexographic press for polyethylene film

press is 27 in. wide, but units can be had in widths from 15 to 30 inches. Printed length ranges from 4 to 35 in. The press handles fine papers, cellophane, foils, and cloth as easily as polyethylene or pliofilm. Features include: forward and side adjustments on the unwind stand, brake tension control; two ink fountain rollers for each color; splash-proof, stainless steel, self-locking ink fountains; and split-type bronze plate cylinder bearings that make changing cylinders fast and simple. *Lee Machinery Corp., 28 W. 23rd St., New York, 10, N. Y.*

Injection cylinder heaters

Thermastrip heating bands are said to be 40% more efficient than any other type. They consist of Calrod-type heating elements encased in aluminum, and feature full-circle heating, uniform heat distribution, and low loss to the surroundings. While each band is built to fit a given cylinder, it is adaptable to as much as ¼ in. variation in cylinder diameter. Heater elements, exceptionally long-lived, can be replaced in seconds on even a hot cylinder. They are available in 1.5- and 2.5-in widths, and in diameters from 4 to 12 inches. Larger bands can be made to order. *Thermal, Inc., 9100 Robinson Rd., Franklin Park, Ill.*

Coiler for flexible pipe

This device is simply two spoked wheels, 7 ft. in diameter, mounted on a central housing that contains the drive mechanism. The wheels are toed in to insure smooth wind-up, while outer guide arms are adjustable for reel width as well as diameter. Driving power, with adjustable speed regulation, may be switched from one wheel to the other with no lost time. The entire unit is mounted on casters with floor locks. *Al-Be Industries, 6103 Clara St., Bell Gardens, Calif.*

Automatic injection machines

Several Formatons have been added to a line of injection molding machines. (Formatons are machines using a vertical clamp to allow the molded products to drop off ejector pins or stripper rings; removal of product is accomplished with an air blast which carries the parts out of the mold and into a chute that has been attached to the rear of the machine.)

Formaton-2 Model A is suggested for automatic molding on comparatively small, inexpensive molds. Heating cylinder pyrometer and controls, all timers, automatic and manual controls, relays, and hydraulic valves are located in one compartment at the front of the machine. The hydraulic system has a rated capacity twice the machine line pressure. Positive regulation of injection pressure is provided. Water-cooled hydraulic heat exchanger is built in. Dual safety devices are used on front gate. Capacity 2 oz./shot; plasticizing capacity 30 lb./hr.; hopper capacity 50 lb.; 260 shots/hr.; pressure on material 20,000 p.s.i.; plunger diameter 1 1/32 inches. Floor space: 35 by 74 by 87 inches.

Formaton-3 Model A is a 3-oz. version of the Formaton-2. A

A tip of the hat

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The purpose of the air scoop cover is to keep insects, dirt, dust and debris out of the air intake while the plane is on field-line operation. *Before* SEILON S-3 was used, cover handles broke off and the covers became cracked and broken in handling.

Westerville Industries, Westerville, Ohio, began making the covers out of SEILON S-3—and there were no more "bugs". A single forming operation shaped the covers with integral handles that stay on, and the toughness and high impact strength of SEILON S-3 ended cover-cracking problems. SEILON S-3 also has a high heat distortion temperature, is resistant to chemicals, oils and many solvents. Available in calendered rolls and sheets, press-laminated sheets, and extruded sheets.

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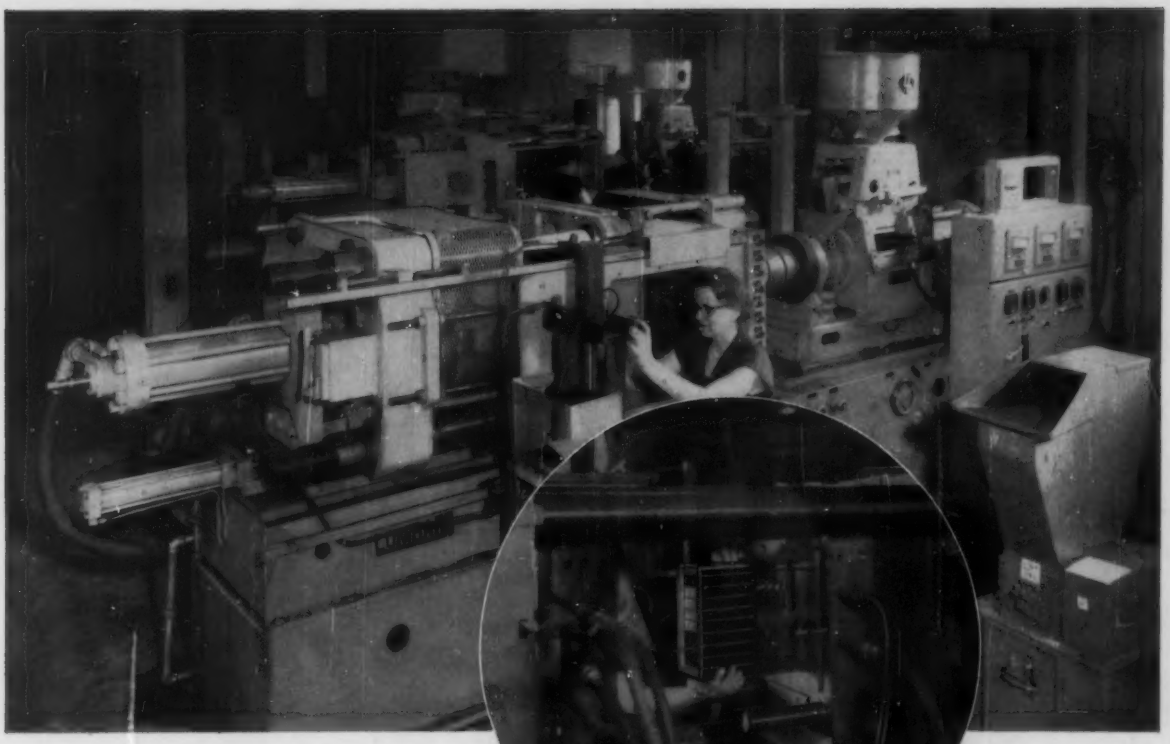
choice of clamps permits operation of any type of standard or index-style mold. The three-rod clamp allows a 30-in. index table to be rotated through the molding position and two or more additional stations in which loading of inserts, hot stamping, or similar operations may be performed. The specifications listed above for the Formaton-2 apply also to the Formaton-3, except for plunger diameter, which is 1¼ in., and floor space, which is 43 by 74 by 78 inches.

The Formaton-C combination automatic injection machine incorporates features of the Formaton-A 3-oz. and -F 4-oz. machines. A powered core remover is timed into the electric and hydraulic circuits to withdraw or unscrew cores prior to mold opening. Machine capacity is 3.5 oz.; plasticating capacity 50 lb./hr.; 250 cycles/hr.; pressure on material 20,000 p.s.i., plunger diameter 1⅜ in., floor space 58 by 74 by 78 inches.

Along with the introduction of these machines, several mold shoes and interchangeable components are offered for molding all sizes and shapes of threaded products. Designed for operation on Formaton-C machines, these tools and interchangeable components permit molding threaded items fully automatically. *Guy P. Harvey & Son Corp., Leominster, Mass.*

Laboratory unit for coating and degassing

Type LC1-14A vacuum system for laboratory, pilot plant, and limited production use is designed primarily for coating of various materials with vaporized metals, but can also be used for degassing liquids, crystal pulling and growing, melting small metal samples, and degassing vacuum-tube electrodes. The unit incorporates a standard pumping system consisting of a 4-in. fractionating diffusion pump and a 5-cu. ft./min. combination roughing and backing mechanical pump with vented exhaust. The pumps are operated by circuit breakers and are interlocked to prevent improper sequencing. Included also are a roughing valve, a backing valve, an air inlet valve,



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and a water-cooled combination valve and baffle above the diffusion pump to minimize backstreaming of oil vapors. All controls are mounted on the cabinet and are easily accessible. The LC1-14A is 88 in. high, 39 in. wide, 30 in. deep, and weighs 635 pounds. The work chamber, a 14- by 24-in. Pyrex bell jar, seats on a base-plate which has holes for vacuum-gage sensing tubes, filament heating electrodes, and accessories. *Rochester Div., Consolidated Electrodynamics Corp., 1775 Mt. Read Blvd., Rochester 3, N. Y.*

Cooling bath

A self-contained dip bath for fast cooling of molded plastics parts provides water temperatures down to 38° F. The bath is said to reduce distortion and sink marks, particularly with pieces of heavy cross section. Incorporating a "Chil-er" refrigerating unit of 6300 B.t.u./hr. capacity at 40° F., bath is easily installed close to the molding machine. The stainless steel tank is 36 by 18 by 10 in. (8-in. water depth). Liquid is recirculated at 10 g.p.m. by a ⅓-hp. pump. The tank has a thermostat control and is mounted on casters; side clips or racks can be had if desired. *Mayer Refrigerating Engineers, Inc., Lincoln Park 4, N. J.*

Roller coaters

Available in four models, the Walco bench-type coater is designed to coat sheet materials, including plastic sheeting, with paints, adhesives, etc. All the rolls —some steel and some rubber— are power-driven by a ¼-hp. motor; the rubber rolls are available in neoprene, thiokol, or Hycar, in lengths from 8 to 52 inches. Grooved rolls are available for heavy adhesives. The different models are: single top-coater, single bottom-coater, and two both-side coating styles. *L. R. Wallace & Co., 191 N. Pasadena Ave., Pasadena 3, Calif.*

Printed-circuit puncher

Using a pantograph-like accessory, the Model 10-AA fabricator is designed specifically for punching printed circuit boards. The 20-ton press reproduces any

pattern of holes in sheets up to 15 by 25 inches in area, punching holes of any shape in sizes ranging from 0.03 to 3.5 in. across. Holes have no cracks, halos, or bell-mouths, are accurately and reproducibly located by the positive clamping mechanism and pilot-pin following the steel master plate. The process can be reversed: a master plate can be punched from a sample printed circuit. Punches can be changed in 15 sec. and the press can make up to 165 strokes per min. (almost 3 per sec.), a rate higher than that at which the operator can guide the pilot pin. *Wales-Strippit Corp., 345 Payne Ave., North Tonawanda, N. Y.*

Temperature controllers

Tipp-Tron controllers automatically indicate and control temperatures ranging from −200 to +3000° F., the exact range (10 available) depending on the model. Some models insure either an upper or lower temperature limit, while others will keep temperature within a band. Control accuracy is said to be held within 2% of the dial setting. Calibration of the indicating meter is shown in both F. and C., and standard thermocouples are used as sensing elements. Where the controller regulates a combustible-gas valve, a special circuit can be had that prevents accidents in case of electric power interruptions. Custom-engineered models will be made on order. *Tipp Mfg. Co., Tipp City, Ohio.*

German machinery

The Hermann Berstorff Maschinenbau, Hannover, West Germany, manufactures a broad line of plastics processing machinery, including laboratory and production calenders, mills, extruders, dies, presses, autoclaves, intensive mixers, pipe and wire take-offs, etc. Extrusion machines range from laboratory models to a 6-in. model for making polystyrene sheet to an 18-inch machine for the rubber industry. A similar range is available in calenders. Injection machines and transfer molding presses appear not to be a part of their regular line. The company has good maintenance facilities in the United States,

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NARROW BAND HEATERS
Give Better Heat for Plastic Molding
BETTER FLEXIBILITY. Individual heaters can be conveniently replaced or shifted in position for best heat distribution. Single burnouts affect only small heat areas, with only fractional heat loss.
EASIER INSTALLATION. Two-piece bands save time. Go in place quickly, without disturbing other heaters.
BETTER CLAMPING. New non-expanding metal clamp goes completely around heater, giving tighter fit and resulting in faster heat transfer, lower internal operating temperature, longer life because there are no air gaps or hot spots to cause burnouts.
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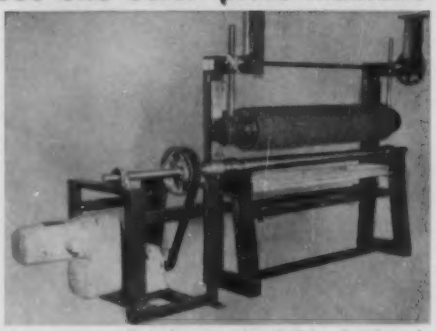
. . . Such FLEXIBILITY . . . Such QUALITY in a low cost one color print machine

Field reports from users of the Liberty Single Color Production Print Machine for plastic films confirm our most enthusiastic expectations:

- **"We like the idea of having a clear view of both the doctor blade and the cylinder at all times."**
- **When printing from the doctor, we can start running with only a pint of ink; two or three quarts do the trick when using the ink pan."**
- **" . . . never seen a machine where coppers could be changed so quickly. Appreciate not having to remove the coppers to wash them up."**



All steel construction. Ball bearing throughout. Widths from 48" to 72" face. To 24" repeat.

Now about price: Liberty does not believe a machine with equivalent features, doing comparable printing, is available anywhere at less than twice the price. We will gladly supply full details. Write for Liberty's new catalog. It describes all Liberty machines.

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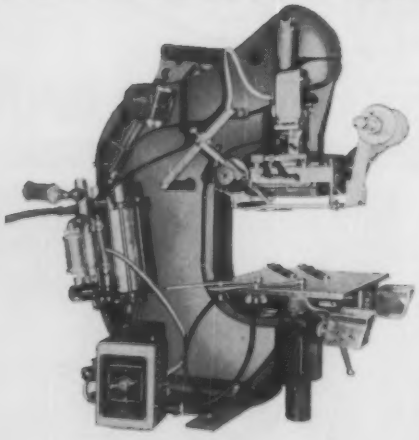


KENSOL 60
Roll Leaf Stamping Press Shown with 6x9 inch Roll Leaf Attachment

OLSENMARK Corporation
124-132 WHITE ST., NEW YORK 13, N. Y.

The KENSOL 60
EXTRA HEAVY DUTY
ROLL LEAF STAMPING PRESS

Featuring
- 3 inch head stroke with 8½ inch opening from head to table. Will imprint items up to 5½ inches high.
- Extra heavy "C" style frame, toggle links and pins. Built for many years of rugged use.

Available with
- One or two air cylinders. When equipped with two cylinders, enough pressure is developed to mark thermo-sets. Second cylinder can be inactivated for light work.
- Standard head sizes of 6" x 9" or 8" x 12". Special heads have been made up to 24" wide to mark refrigerator parts, etc.

Write for complete data!
- Literature will be sent on complete line of Kensol Equipment which includes hand operated and power operated presses, turntables, etc.
- Roll leaf color chart showing complete line of Olsen Mark Leaf will also be sent.

Specialists in Quality Marking Equipment and Supplies for over 30 years

sends men from Germany to supervise the installation and running-in of the heavier equipment. Herman Berstorff is represented in the U. S. by *Transmares Corp., 15 William St., New York 5, N. Y.*

Drill for sheet plastics

The Roto-Bor is a different approach to the problem of cutting holes in a thin sheet, something difficult to do with standard drills. It consists of two rotating points centered on a shaft having a pointed retracting positioning tip. Mounted in any drill press or hand drill, it cuts through the sheet around the circumference of the circle only, in somewhat the fashion of a hole saw. Result is a clean cut and an accurate, chip-free hole. Transmitted torque is small, so workpieces may be hand held. 54 stock sizes range from 3/16 to 1 9/32 inches. *Jancy Engineering Co., 508 S. Pine St., Davenport, Iowa.*

Jancy Roto-Bor for cutting holes in thin sheet

Nickel-sheathed cartridge heaters

Mighty Watt cartridge heaters, available in a variety of dimensions and wattages, are now built with a nickel alloy sheath instead of the formerly used brass sheath, which oxidized rapidly at high temperatures. The oxide film cut the rate of heat transfer, requiring the thermal element to operate at higher temperature in order to dissipate its wattage, and causing many burnouts. The thermal conductivity of the nickel alloy is said to be equal to that of brass. The new Mighty Watts

have been widely tested and found superior in plastics processing equipment. *Ogden Mfg. Co., 2502 Irving Park Rd., Chicago 18, Ill.*

Strippable coating keeps metallizing chambers clean

Vacuumguard is a vinyl-based strippable coating that can be sprayed or brushed on the inside surfaces of vacuum metallizing equipment. A 2- to 3-mil coating is usually sufficient, but thicker coatings may be used. Properly applied, the coating will be ready for use in less than a day. It is said to be the only such coating that will not outgas under the high vacuums involved in metallizing. When the excess evaporated metal is to be removed, the strong (tensile strength over 2000 p.s.i., elongation about 185%) film is simply stripped out of the metallizer. Precious metals may be recovered by dissolving the film in aromatic or ketone solvents. *Guard Coatings Corp., 8-05 43rd Ave., Long Island City 1, N. Y.*

Automatic tension controller

The Jordan Dancetrol provides automatic tension control from a few ounces up to several hundred pounds in the winding of paper, plastic webs, and tapes. It holds constant web velocity up to several hundred ft./min., is readily adapted to dancer rolls or pivot arms on existing machines, and may easily be incorporated as part of a new machine. Two types are available: one provides on-off control of drive motors or pilot motors of variable speed drives; the other gives proportioning control for variable speed drives. *The Jordan Co., 3235 W. Hampton Ave., Milwaukee 9, Wis.*

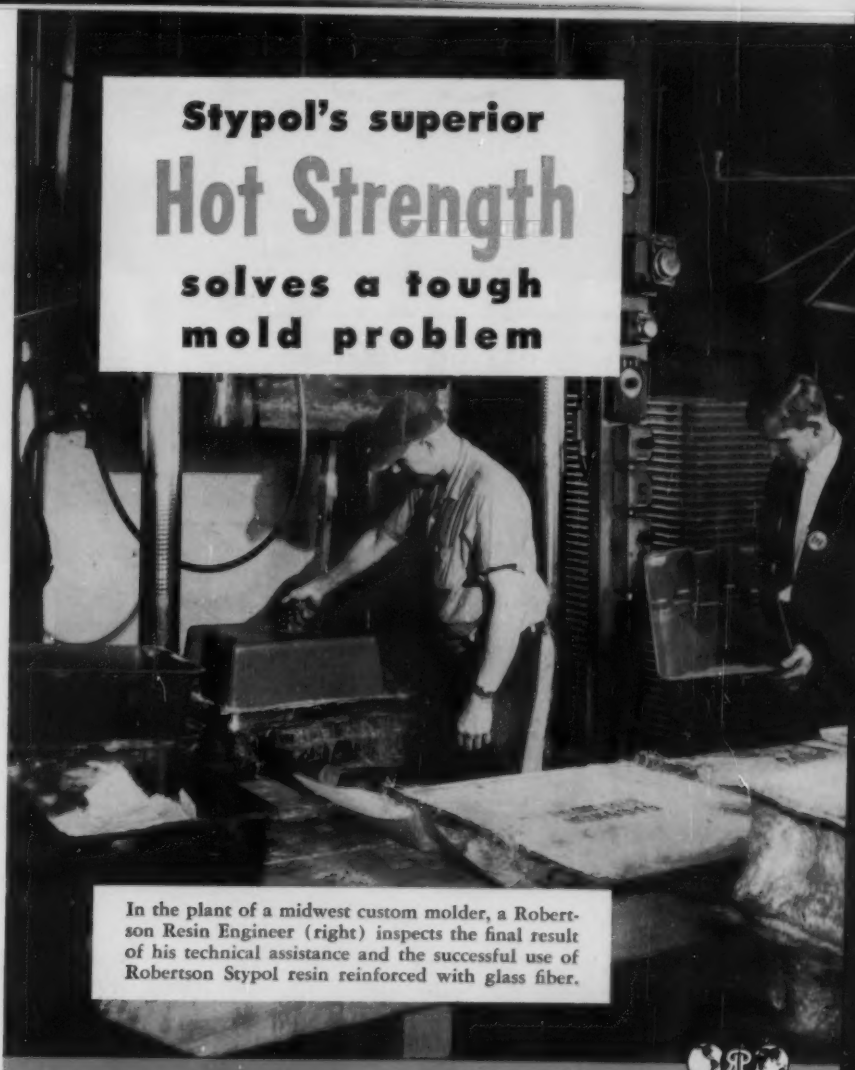
Hot-air blower

This unit resembles a ladies' home hair dryer, but is more ruggedly built. It is designed to provide 50 cu. ft./min. of air heated to 300° F., with an air velocity of 33 ft./sec., for accelerating drying processes and for localized heating. Rated at 1000 watts, it operates only on 115-v. a.c. *Master Appliance Mfg. Co., 536 Fourth St., Racine, Wis.*

Stypol's superior

Hot Strength

solves a tough mold problem



In the plant of a midwest custom molder, a Robertson Resin Engineer (right) inspects the final result of his technical assistance and the successful use of Robertson Stypol resin reinforced with glass fiber.

Robertson Stypols (polyesters) offer outstanding craze and blow resistance on short high temperature cure cycles plus far better than average hot strength and mold release properties, particularly in complex large moldings. One of the Stypols resists crazing in paint oven systems up to 260°F. In addition, these resins have an unusual ability to bury fibers so that the surface of molded parts is very smooth to the touch. Clip the coupon below and attach it to your letterhead if you would like a qualified Robertson engineer to work in your shop with you on your specific problem.

ROBERTSON **STYPOL** RESINS

*One of the world's largest producers of specialty asphaltic and polyester compounds

H. H. ROBERTSON CO.

2400 Farmers Bank Building Pittsburgh, Pa.

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COMPANY

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Books & Booklets

Write for these publications to the companies listed. Unless otherwise specified, they will be sent gratis to executives who request them on business stationery.

"Creative Communication"
By E. L. Cady

Published in 1956 by Reinhold Publishing Corp. (a Pilot Book) 430 Park Ave., New York 22, N. Y. 158 pages. Price: $2.50

The author begins with a broad definition of "creative" as it applies to technical writing. Poor communication, he says, results from overinterpreting too little information, and from catharsis —overtelling and overemphasizing a point to "get it off your mind." Cathartic authors are advised to destroy their communications or have them severely edited. Mr. Cady discusses the multi-editor problem with some whimsy and some sound advice. Example: multiple editors are more prone to "improve" your prose than your drawings, graphs, etc.; therefore, rely more heavily on those elements which they are most likely to leave alone. When communications are to be presented both orally and in writing he advises: write the printed version, simplify it for your talk, then use the simplified version in print. A refreshing little book on a mushrooming problem.

Epoxy resin adhesives. Bulletin gives engineering data on high-strength epoxy resin adhesives for metal-to-metal bonding, honeycomb sandwich construction, permanent anchors for metal and plastic parts, tool repairing, and sealer and crack filler. 11 pages. *Adhesives and Coatings Div., Minnesota Mining and Manufacturing Co., 411 Piquette Ave., Detroit 2, Mich.*

Curing agent. Chemical composition, physical properties, chemical reactions, operating procedure, formulation, advantages, and toxicology of Tonox-PL, a curing agent for epoxy resins, are discussed in a new bulletin. A graph showing the viscosity change of Tonox-PL with increase of temperature is included. 6 pages. *Naugatuck Chemical, Div. of United States Rubber Co., Naugatuck, Conn.*

Nomograph. Users of foamed-in-place urethane formulations can now quickly calculate material costs with the new Costimator. This is believed to be the first such nomograph created for manufacturers utilizing liquid components for foamed-in-place and flexible urethane foam materials regardless of their raw material supplier. It is printed in 5½- by 8-in. pad form. *Dayton Rubber Co., Dept. 72, Dayton 1, Ohio.*

Cast vinyl film. Vinyl film made by the casting method is described in a booklet titled, "Krene Cast Vinyl Film." The film's uses and properties are discussed, and its brilliant clarity and toughness are demonstrated by a nearly invisible leaf of the material which is bound into the booklet. 20 pages. *Bakelite Co., a Div. of Union Carbide and Carbon Corp., 30 E. 42nd St., New York 17, N. Y.*

Injection machine nozzles. The 1957 injection machine nozzle catalog, completely priced, contains a section on the new heated mixing nozzles as well as an expanded list of stock model nozzle taps. Included are technical notes on nylon molding and general nozzle design. 48 pages. *Injection Molders Supply Co., 3514 Lee Rd., Cleveland 20, Ohio.*

Pellet mill. Bulletin No. 165 describes the Junior Model 500-B Pellet Ace which has applications in densifying and compacting into pellets such materials in powdered form as low-pressure polyethylene; polyvinyl chloride, and polyvinyl chloride compounded with stabilizers, plasticizers, and clays, etc.; polystyrene; cellulose acetates, phenolics, wood flour, etc. 4 pages. *Sprout, Waldron & Co., Inc., Muncy, Pa.*

Laboratory supplies. Catalog E956 lists and illustrates over 60 laboratory items made of polyethylene, tubing made of plasticized polyvinyl chloride, sponge made of polyurethane, and tube fittings made of nylon. 16 pages. Available from *The Nalge Co., Inc., 625 S. Goodman St., Rochester 20, N. Y. and Palo Laboratory Supplies, Inc., 81 Reade St., New York 17, N. Y.*

Puerto Rico facts. A reference book for plastics products and other manufacturers, "Puerto Rico Facts for the Manufacturer" describes the country's tax-free industrialization program and outlines both advantages and disadvantages for plastics products manufacturers in the Commonwealth. 72 pages. *Publications Office, Commonwealth of Puerto Rico, Economic Development Administration, 579 Fifth Ave., New York 17, N. Y.*

"Fabrics Plus" is a booklet about fabrics used in combination with other materials to do special tasks. Text and illustrations describe fabric development, fibers and yarns, fabric construction, typical fabrics used in combination with other materials, fabrics and rubber, coated fabrics and supported film, fabrics in laminates, and fabrics for abrasives. A chart lists each of a number of fiber forms and types, giving tenacity; tensile strength; elongation; specific gravity; percent of moisture regain and absorbency; effect of heat, sunlight, acids, alkalis, organic solvents; and resistance to mildew. 28 pages. *Wellington Sears Co., 65 Worth St., New York 13, N. Y.*

Polyvinyl chloride piping. Bulletin CE-56 describes Ace Riviclor, an unplasticized rigid polyvinyl chloride with exceptional chemical resistance, aging charac-

fast curing... general purpose

INDUR 205 BROWN

PHENOLIC MOLDING COMPOUND

A woodflour-filled, two-step compound, standard NEMA brown, with excellent electrical properties, superior surface finish, and universal molding qualities.

For top quality, fast production you can count on INDUR 205 General Purpose Brown. Let our technical staff assist you in obtaining the advantages of using INDUR 205 in your shop.

For samples and specification data on INDUR 205 Brown or other browns with same superior properties, please write.

PROPERTIES*

Flow Range	Soft to Hard
Granulation	16 Mesh
Bulk Factor	2.4-2.7
Mold Shrinkage	0.005-0.007 in./in.
Molded Specific Gravity	1.38-1.39
Heat Distortion Temperature °F.	290 min.
Water Absorption	0.5% max.
Tensile Strength	6,500 psi min.
Flexural Strength	9,000 psi min.
Compressive Strength	30,000 psi min.
Impact Strength, Izod	0.30 ft. lbs./in. of notch, min.
Dielectric Strength, Short Time	300 volts/mil, min.
Dielectric Strength, Step by Step	200 volts/mil, min.
Dielectric Constant @ 1,000 cycles	7.0 max.
Power Factor @ 1,000 cycles	0.07 max.

**Approximate values based on standard ASTM test methods wherever possible.*

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teristics, and toughness, which was developed especially for process piping. Included in the bulletin are technical properties, a table of resistance to chemicals, data on sizes, pressures, and dimensions, and prices for pipe, fittings, and valves from ½ to 2 inches. Instructions for threading, forming, and other installation operations are also given. 8 pages. *American Hard Rubber Co., 93 Worth St., New York 13, N. Y.*

Molded plastics. Manual on molded plastics gives thumb-nail case histories of 12 different applications ranging from automotive timing gears through display boxes to washing machine agitators. 8 pages. *The Richardson Co., 27th Ave. & Lake St., Melrose Park, Ill.*

Foam cushioning. Folder highlights some of the important recent uses of Vinylfoam, a new open-cell, flexible foam cushioning material. A physical properties chart is included. 4 pages. *Elastomer Chemical Corp., 212 Wright St., Newark 5, N. J.*

Glass reinforcement. "Futures Unlimited," a 26-min., 16-mm. color and sound film, describes the use of glass reinforcement in items ranging from aircraft radomes to modern furniture. Give suggested dates for showing to *Sales Promotion Dept., L.O.F. Glass Fibers Co., 1810 Madison Ave., Toledo 1, Ohio.*

Gasket thermocouples. Bulletin on miniature gasket thermocouples contains information on available calibrations, temperature ranges, and sizes. A separate section deals with terminals and quick-coupling connectors for aircraft and miniature thermocouples. 6 pages. *Thermo Electric Co., Inc., Saddle Brook, N. J.*

Latex for paper coatings. Dylex K-52, a styrene-butadiene copolymer latex for use in coating printing papers, is described in Technical Bulletin C-6-239T. A complete analysis of the properties of the new latex in comparison with those of a competitive material is presented. Factors discussed are physical properties, mechanical strength, recommendations for machine and off-machine coating, preparation of the formulation, and rheology. As an added feature, the paper stock used in the preparation of this bulletin has been coated with the new latex. 20 pages. *Chemical Div., Koppers Co., Inc., 1450 Koppers Bldg., Pittsburgh 19, Pa.*

Odorless solvent. Illustrated booklet describes Immunol, a neutral, non-toxic, non-flammable, odorless solvent said to clean, degrease, and rustproof metal surfaces in one operation. Applications and grades available are listed. 12 pages. *Harry Miller Corp., 4th & Bristol Sts., Philadelphia 40, Pa.*

Carbon black. A procedure for the direct determination of the degree of carbon black dispersion in polyethylene masterbatches is described in a new bulletin entitled, "The Evaluation of Carbon Black Dispersion in Polyethylene Masterbatches." A bibliography is included. 7 pages. *Special Blacks Div., Godfrey L. Cabot, Inc., 77 Franklin St., Boston, Mass.*

Valley inks. Bulletin No. 345 describes the company's MB Series, a complete ink system for valley printing on treated polyethylene. A price list and recommendations for use are included. 2 pages. *Claremont Pigment Dispersion Corp., 39 Powerhouse Rd., Roslyn Heights, Long Island, N. Y.*

Dry coloring. Folder gives answers to a number of the most commonly asked questions concerning the dry coloring of polystyrene wall tile. 2 pages. *Ferro Corp., 4150 E. 56th St., Cleveland 5, Ohio.*

"Antistatic Agents for Polyethylene" is the title of a technical bulletin that discusses Electrosols D, M, S-1, and S-1-X. The bulletin covers properties, applications, and uses. 4 pages. *Alframine Corp., 72-76 Putnam St., Paterson 4, N. J.*

Color concentrates. Technical Bulletin No. 220 covers the PE Series, a complete range of granular color concentrates for coloring polyethylene. Discussed are heat and light stability, migration and crocking, alkali resistance, relative strength, and uses and methods of application. General recommendations and a price list are included. 7 pages. *Claremont Pigment Dispersion Corp., 39 Powerhouse Rd., Roslyn Heights, Long Island, N. Y.*

Controlled-pressure presses. Folder describes and illustrates the following PHI presses: floor type production press, bench press for laboratory and research, medium size molding press, small molding and laminating press, and an open side press. *Pasadena Hydraulics Inc., 279 N. Hill Ave., Pasadena 4, Calif.*

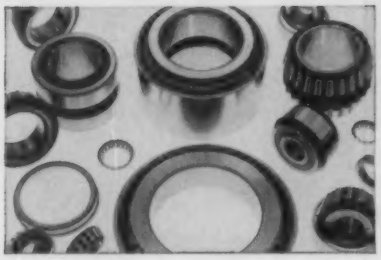
Metallic films. Booklet PB 121175, "Vacuum Evaporation of Heavy Metallic Films," by W. R. Turner, of the Naval Ordnance Laboratory, describes new evaporation equipment capable of forming metallic films 10 to 40 times the thickness of films obtained in commercial practice. 34 pages. Price: $1.00. *Office of Technical Service, U. S. Department of Commerce, Washington 25, D. C.*

Design service. Bulletin describes a new design service claimed to utilize low cost fabrication methods. It covers corrosion-resistant heat exchangers, chlorine coolers, falling film absorbers, and towers of all types. 4 pages. *Haveg Industries, Inc., 900 Greenback Rd., Wilmington 8, Del.*

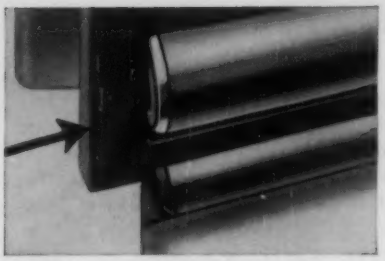
Vending displays. "How to Select Vending Displays That Increase Sales" shows how the vending display stand can be effectively tied in with over-all merchandising efforts, designed to win dealer acceptance, and tailored to fit the budget. Twenty modern corrugated displays are illustrated and described. 36 pages. *Hinde & Dauch, Sandusky, Ohio.*

Chemical products. Bulletin gives physical properties and applications of vinyl monomers, acetylenic alcohols, glycols and hydrocarbons, ditertiary glycols,

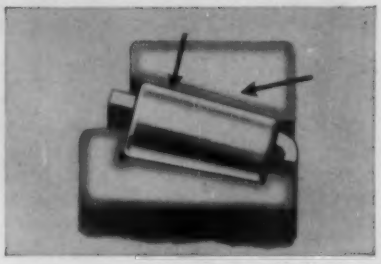
Get all these advantages . . . specify TIMKEN® tapered roller bearings



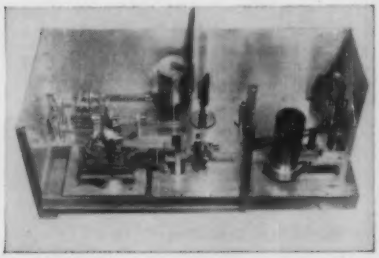
THERE ARE 27 TYPES of Timken® tapered roller bearings. This wide selection means you get the bearing design exactly suited to your job. Whatever your bearing application problem, we can help solve it.



THE SOFT STEEL CAGE used in Timken tapered roller bearings separates the rollers, keeping them spaced evenly. This prevents scuffing of the rollers, adds to the bearing life and gives you more for your money.

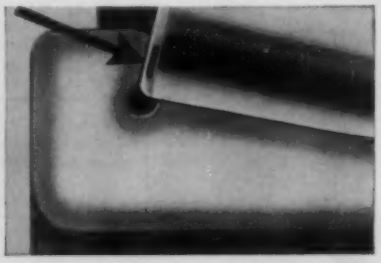


HARD ON THE OUTSIDE, tough on the inside. To take shock loads, give longer life, Timken bearing rollers and races are case-carburized to have a hard, wear-resistant surface over a tough, shock-resistant core.



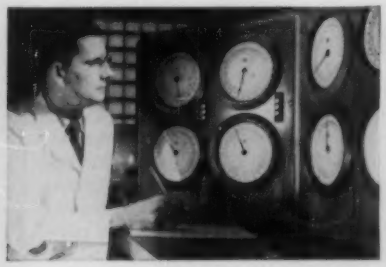
MICRO-INCH FINISH is standard for Timken bearings. This profilograph checks contours and smoothness of circular surfaces to a millionth of an inch, helps us make Timken bearings truer, quieter, longer-wearing.

6,525 SIZES, the world's largest selection of tapered roller bearings. From bearings smaller than your finger to 71½" in inside diameter, the Timken Company can supply the size you need for any specific application.

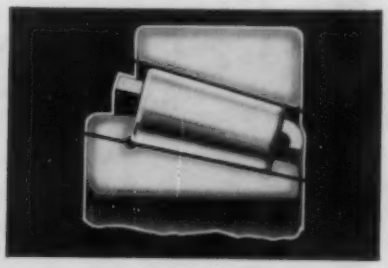


POSITIVE ROLLER ALIGNMENT is assured because the taper in Timken bearings holds ends of rollers snug against the rib. The taper in Timken bearings lets them take radial or thrust loads or any combination.

ACCURATE TO 50 MILLIONTHS of an inch. This Universal Measuring Machine checks gages and machine parts used to make Timken bearings. Our gage laboratory, one of the world's best equipped, helps make Timken tapered roller bearings your No. 1 bearing value.



WE MAKE OUR OWN FINE ALLOY STEEL. No other American bearing maker does. This spectrometer helps control steel quality—in 40 seconds gives the exact chemical analysis of a melt. In a few minutes, results are flashed to the melter. It's another step in rigid quality control.



FULL LINE OF CONTACT between Timken bearings' rollers and races gives them *extra* load-carrying capacity. To get *all* these advantages, specify "Timken". The Timken Roller Bearing Company, Canton 6, Ohio. Canadian plant: St. Thomas, Ontario. Cable address: "TIMROSCO".

TIMKEN *TAPERED ROLLER BEARINGS ROLL THE LOAD*

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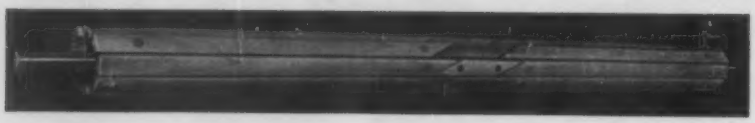
Auxiliary Extrusion Equipment



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rigid pipe pull off
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Smoothes out plastic film and fabrics during continuous roll operations. Expander slats move outward from center, pressing out any creases or wrinkles in the web. Permits operation of processing machinery at higher speeds. Delivers tight, neat rolls, improves printing register, cuts reject losses.

Progressive manufactures a wide range of equipment designed for handling the extrusion after it leaves the die. Progressive units are easily adjusted, give years of trouble-free operation, and reduce scrap losses considerably.

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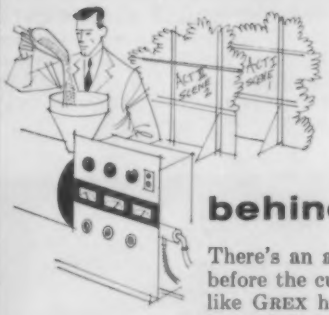

behind the scenes . . .

There's an air of excitement behind the scenes before the curtain goes up on a fine new plastic like GREX high-density polyethylene. Dress rehearsals for this resin's debut are being conducted continuously in our laboratory's commercial types of extruder and injection molding equipment. Thus we're producing and reproducing the performance data you'll use—and applaud—when GREX is available in commercial quantities. P. S. We're predicting a hit!

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*Trademark for W. R. Grace & Co.'s polyolefins

POLYMER CHEMICALS DIVISION
W. R. GRACE & CO.

and non-ionic surface active agents. 4 pages. *Air Reduction Chemical Co., 150 E. 42nd St., New York 17, N. Y.*

Air cylinders. Complete engineering data on Series A nonrotating air cylinders, valves, and accessories is given in illustrated Catalog No. 110. Twenty-one models of cylinders, with bore sizes ranging from 1½ through 14 in., are covered. 11 pages. *The S-P Manufacturing Corp., 30201 Aurora Rd., Solon, Ohio.*

Plastisol coating systems. Bulletin No. 83, revised and expanded, describes in detail a new system offered to industrial plants for coating parts and assemblies with polyvinyl chloride plastisols to ensure corrosion resistance. A sample layout of the system is pictured and the step-by-step procedure used in applying the coating is shown. Included is a listing of the equipment involved and the service extended by the company in setting up the system. 4 pages. *Quelcor, Inc., Front and Broomall Sts., Chester, Pa.*

"Autothermal Extrusion" is the title of a technical service bulletin that describes a system of extruder operation where the frictional heat from working the material in the extruder barrel is the sole source of fluxing heat. 3 pages. *Koppers Co., Inc., 1450 Koppers Bldg., Pittsburgh 19, Pa.*

Polystyrene for lighting. Technical Bulletin C-6-162 describes Evenglo, a series of specially pigmented polystyrenes said to be strong, light in weight, and economical for use in lighting applications. The bulletin outlines the physical properties of these polystyrenes. 20 pages. *Chemical Div., Koppers Co., Inc., 1450 Koppers Bldg., Pittsburgh 19, Pa.*

Molding compounds. Illustrated folder, entitled "Designing with Plaskon Plastics and Resins," describes physical and electrical properties, chemical resistance, and special molding advantages of the compounds, and discusses the strength, dimensional stability, and light weight and durability of fibrous glass-reinforced

Plaskon polyester resins. 4 pages. *Barrett Div., Allied Chemical & Dye Corp., 40 Rector St., New York 6, N. Y.*

Organic chemicals. Booklet F-6136 describes more than 335 organic chemicals, including 21 new products, available from the company. Condensed data on applications are presented and physical properties are given in tabular form. An alphabetical index is included. 24 pages. *Carbide and Carbon Chemicals Co., 30 E. 42nd St., New York 17, N. Y.*

Small machine lubrication. Bulletin 4C, "Metered Lubrication for the Small Machine," describes and illustrates automatic and semi-automatic centralized lubricating systems for a wide range of small units, and describes an extensive line of cyclic and "one shot" lubricators. 24 pages. *Bijur Lubrication Corp., 151 W. Passaic St., Rochelle Park, N. J.*

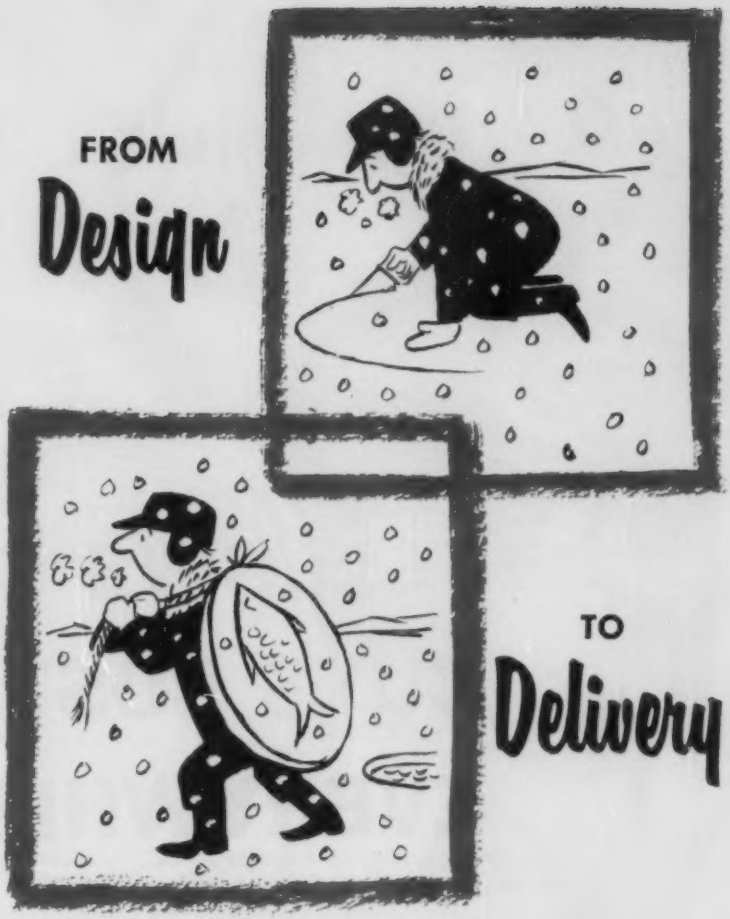
Testing machines. Bulletin No. 54 gives complete information and specifications for standard Electomatic universal testing machines of from 500- to 1,000,000-lb. capacity as well as comprehensive descriptions of the independent loading, weighing, and indicating systems that are part of all models. 40 pages. *Tinius Olsen Testing Machine Co., Dept. 5760, Easton Rd., Willow Grove, Pa.*

Power tools. Catalog No. 57 gives descriptions, specifications, and illustrations of power tools for cutting, drilling, and finishing plastics, metals, and wood. 52 pages. *Boice-Crane Co., 972 West Central Ave., Toledo 6, Ohio.*

Phenolic products. Catalog CDC-322 describes the company's entire product line of phenolic molding materials and resins. 10 pages. *Chemical Materials Dept., General Electric Co., One Plastics Ave., Pittsfield, Mass.*

Methylene chloride. Complete technical information on methylene chloride and the advantages this chemical offers for use as an aerosol pressure depressant, vapor degreasing solvent, cold

(*To page 242*)



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Intricate or simple, large or small, it really doesn't matter . . . if your job involves plastics, we can help you. Our design, engineering, laboratory and production facilities are at your service. We can help you select the right material and the right process, because we work practically all thermosetting and thermoplastic materials . . . by injection, compression, transfer molding, and vacuum forming. For the complete job — from drawing board stage to finished part or product — it will pay you to consult Watertown . . . *first!*

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1000 ECHO LAKE ROAD, WATERTOWN, CONN.

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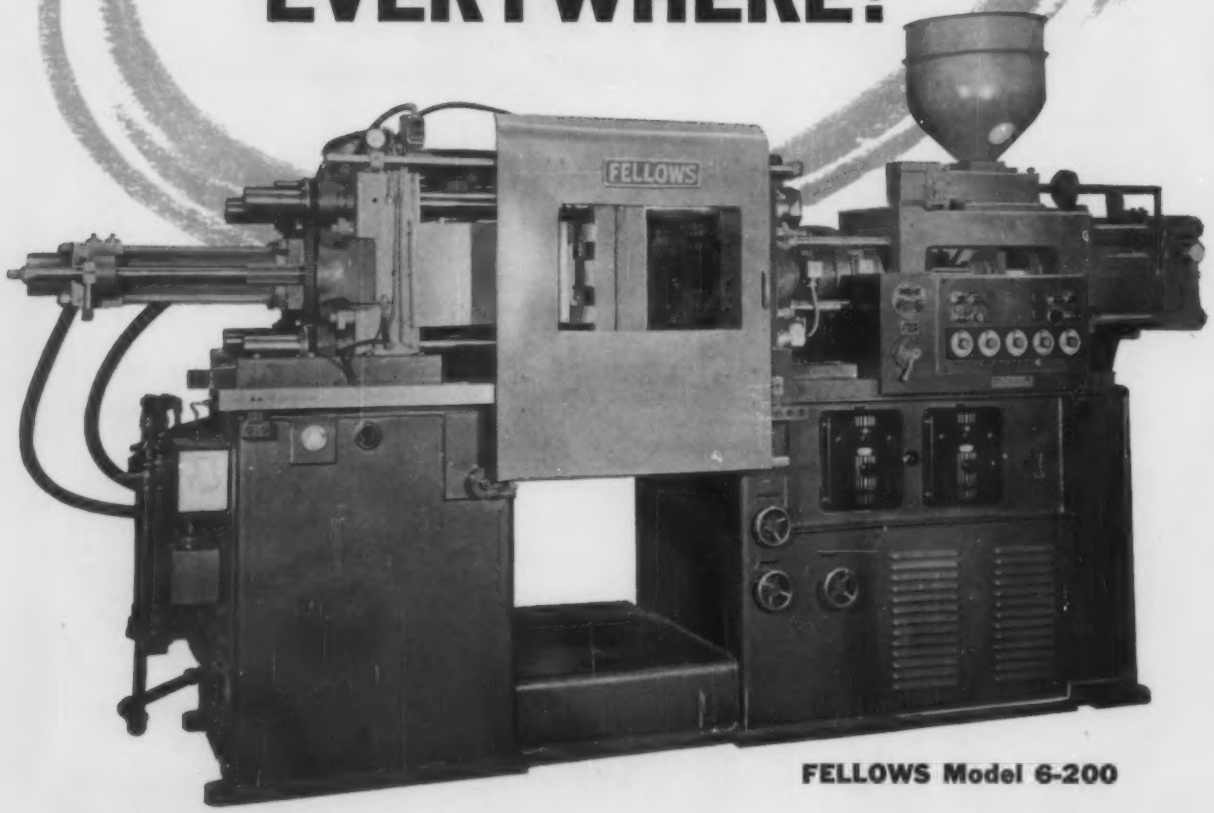
FELLOWS SPEED CUTS COSTS EVERYWHERE!



FELLOWS Model 6-200

to Precision Nylon Gears...

Everywhere in the industry, the versatile Fellows 6-200 is setting new production standards with higher speed (*and* fewer rejects), larger shots, and true full-automatic operation even on the most difficult parts!

Whether you're molding acrylics or Nylon, polyethylene or polytrifluorochloroethylene, you'll get faster cycling and easier operation with the Fellows 6-200. Built-in controls are sensitive and accurate to speed set-ups and change-overs, minimize rejects, provide safe, fast automatic operation. One man can operate three or more machines.

One control sets mold height and clamping adjustment. Stroke length adjustment provided on both press and injection ends. Press assembly retracts for easy purging. And you get up to *nine ounces* per shot with the optional pre-pack device, dry run speeds from 490 to 650 cycles per hour!

See for yourself how the production versatility of the Fellows 6-200 can lower *your* costs per piece. And see how the versatile *Fellows Plans* for deferred payment can provide convenient short or long-term financing that lets you pay for your Fellows 6-200 while it's producing for you. Ask your Fellows representative for the facts. Get in touch with any Fellows office.

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injection molding equipment

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How this housing was made for Coca-Cola from Tenite Butyrate plastic

HANDSOME, DURABLE DISPENSER was designed and manufactured by Glascock Bros. Mfg. Co., Muncie, Indiana, with the cooperation of the firms listed below.

Bright white top is one of largest one-piece, deep-drawn plastic housings ever produced. General Plastics Corp., Marion, Indiana, first extruded sheet of Tenite Butyrate, then vacuum-formed the sheet to produce both the top and sides.

Front panel gains added beauty from metallizing process. Panel was both vacuum-formed and metallized by Kent Plastics Corp., Evansville, Indiana, from sheet of Tenite Butyrate extruded by General Plastics Corp.

Many products, like the Coca-Cola dispenser described above, are being redesigned to take advantage of the properties of Tenite Butyrate. This versatile Eastman plastic is described more fully on the opposite page.

TENITE
BUTYRATE
an Eastman plastic

cleaning solvent, extraction solvent, and secondary refrigerant are given in "Methylene Chloride, The Better Multipurpose Solvent." 24 pages. *The Dow Chemical Co., Midland, Mich.*

Industrial liquid meters. Bulletin OG-400, a revised edition of the company's ER industrial meter bulletin, offers more complete temperature, viscosity, pressure, and registration data than was included in the older publication. 16 pages. *Meter and Valve Div., Rockwell Mfg. Co., 400 N. Lexington Ave., Pittsburgh 8, Pa.*

Coated fabrics. A listing of many stock and standard fabric constructions, and a brief discussion of properties, applications, base fabrics, and coatings are included in a bulletin on COHRlastic silicone rubber coated fabrics and nylon resin coated nylon fabrics. 4 pages. *The Connecticut Hard Rubber Co., 407 East St., New Haven 9, Conn.*

Packaging with plastics. The "1957 Guide to Improved Packaging" describes and illustrates how the company's polyethylene, styrene, vinyl, and phenolic plastics can effect economies in getting products to customers. The Guide is designed to aid the package maker, wholesaler, and retail store manager solve their packaging problems. 10 pages. *Bakelite Co., a Div. of Union Carbide and Carbon Corp., 30 E. 42nd St., New York 17, N. Y.*

Small thermoplastic parts. Folder tells how design engineers can solve many planning and production problems with tiny thermoplastic components produced to precise tolerences by a completely automatic injection molding process in a single operation (maximum size: 0.03 oz., 1¼ in. long; no minimum size). 4 pages. *Gries Reproducer Corp., 125 Beechwood Ave., New Rochelle, N. Y.*

PVA bulk storage. Technical Bulletin PVB No. 522, "Bulk Storage of Polyvinyl Acetate Emulsions," presents a schematic view of a bulk storage plant, describes methods of shipment, storage tanks, and piping and valves, and gives pump and installation costs. 4 pages. *Colton Chemical Co., a Div. of Air Reduction Co., Inc., 1747 Chester Ave., Cleveland 14, Ohio.*

Shielded thermocouples. Bulletin describes the uses, construction, immersion lengths, thermocouple leads, and terminals of small shielded thermocouples for measuring temperatures of gases and vapor mixtures of gases and liquids. 6 pages. *Thermo Electric Co., Inc., Rochelle Park Post Office, Saddle Brook, N. J.*

Potentiometer pyrometer. Bulletin 9B describes an improved portable potentiometer pyrometer with interchangeable direct-reading scales. 8 pages. *Technique Associates, 211 E. South St., Indianapolis 25, Ind.*

Valves. Circular No. 555, a revised edition of "Guide for Selecting Valves, Boiler Mountings, Lubricating Devices," has new sections describing bronze globe valves, with Brinalloy seats and disks; Luncor PVC all-molded valves; and Lunkenheimer solder end valves. 24 pages. *Lunkenheimer Co., Cincinnati 14, Ohio.*

Teflon. Bulletin T-50 discusses Teflon tetrafluoroethylene resin as it applies to the company's equipment now in production, including thin- and heavy-walled tubing and rod, steel pipe lining, insulated wire, machine parts, and sheet. 4 pages. *Halocarbon Div., Haveg Industries, Inc., 900 Greenback Rd., Wilmington 8, Del.*

PVC valves. Catalog C1056 describes a series of corrosion-resistant PVC Micro-Meter needle valves and Micro-Flow globe valves. Cutaway photos and drawings show port connections and internal construction of both types. Applications, dimensions, and specifications are outlined. 4 pages. *Chemtrol Corp., 1513 West El Segundo Blvd., Compton, Calif.*

Blending methods and equipment. Brochure discusses dry mixing, blending, drying, and dispersing of process materials, explaining the multi-action principles inherent in Double Cone

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Blender operation and describing the new Rota-Cone vacuum dryer. 8 pages. *Paul O. Abbé Inc., 953 Center Ave., Little Falls, N. J.*

Injection cylinders. Report covers the melt extraction and poly-liner type heating chambers devised by Dow and Du Pont, respectively, and describes the advantages and disadvantages. 6 pages. *Injection Molders Supply Co., 3514 Lee Rd., Cleveland 20, Ohio.*

Epoxy case molds. Technical Bulletin No. 17 describes the company's newly developed Sonite system for making case molds from epoxy resins. Mixing data is included. 4 pages. *Smooth-On Mfg. Co., Jersey City, N. J.*

Antioxidants. Folder gives structural formulas, properties, and popular applications of various Tenox food-grade antioxidants. 4 pages. *Eastman Chemical Products, Inc., Kingsport, Tenn.*

"The House of Today . . ." describes and illustrates by means of a cut-away drawing typical applications for Geon rigid vinyl plastics in home construction and furnishings. 8 pages. *B. F. Goodrich Chemical Co., a Div. of B. F. Goodrich Co., 3135 Euclid Ave., Cleveland 15, Ohio.*

Vacuum-trimming machine. Illustrated brochure describes the three-in-one operation—vacuum forming, drape and plug forming, and automatic trimming of thermoplastic sheets—of the VacTrim machine which completely processes plastics sheets into finished products. 4 pages. *Vacuum Forming Corp., 76 S. Bayles Ave., Port Washington, N. Y.*

Epoxy-based alloy. Brochure describes three new epoxy-based alloys for joining, filling, cladding, and surfacing masonry materials. They are described as the first products in construction history capable of welding such materials with a bond stronger than masonry itself. The products are Permagile Compound, a syrupy, self-leveling paste for joining, cladding, and filling (neutral in color); Permagile No. 10, a

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heavier, viscous, adhesive paste for joining and filling in vertical and overhead applications (neutral in color); and Permagile Plastic Armor, a liquid surfacer (available clear and in colors). 6 pages. *Permagile Corp. of America, 37-23 33rd St., Long Island City 1, N. Y.*

Testing. "Tables and Data," together with Supplement No. 1, presents selected scientific and engineering tables and data under the following classifications: plastics, chemical and physical, engineering, leather, textiles, psychometrics, and bacteriology. 124 pages. *United States Testing Co., Inc., 1415 Park Ave., Hoboken, N. J.*

Humidification. Bulletin No. 492 entitled "A Few Facts About Humidification for Industry" points out advantages inherent in controlled humidification. A number of humidifiers for industrial, commercial, and small areas are shown. 4 pages. *Abbeon Supply Co., 178-15 Jamaica Ave., Jamaica 32, N. Y.*

Plasticizers. Bulletin No. 07-75-2-10-56 describes the company's line of Polycizer plasticizers and gives information on their chemical and physical properties, performance, and use in plastisols and wire and cable coating. 3 pages. *Harwick Standard Chemical Co., 60 S. Seiberling St., Akron 5, Ohio.*

Vinyl resins. Test data and typical physical properties of six Exon vinyl chloride resins for solution coatings are given in Sales Service Bulletin No. 23. 33 pages. *Chemical Sales Div., Firestone Plastics Co., a Div. of The Firestone Tire & Rubber Co., Pottstown, Pa.*

Acrylic rods, tubes, and shapes. Bulletin illustrates a wide range of acrylic rods, tubes, and shapes, carried in stock for immediate delivery, including hard-to-obtain shapes. Illustrations of products in which acrylic material is used—and tables tabulating the physical properties of the material are included. 4 pages. *Ace Plastic Co., 91-30 Van Wyck Expressway, Jamaica 36, N. Y.*

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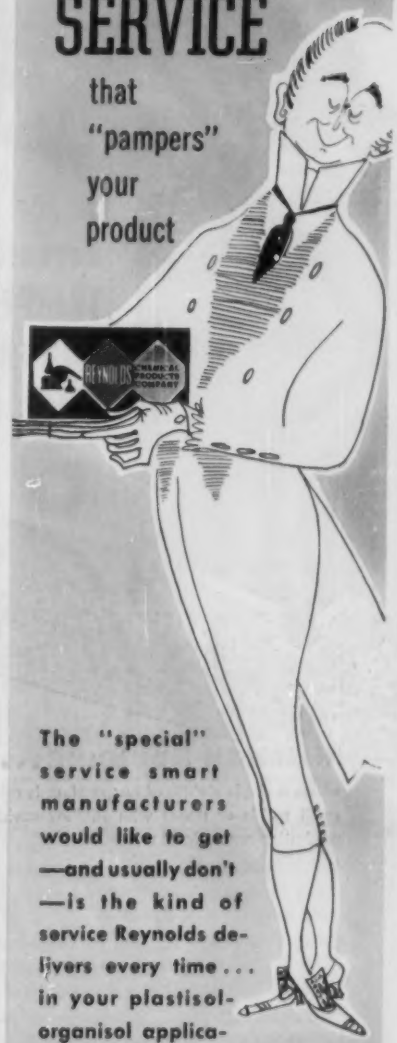

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mp Plastics

Production and sales figures in 1000 lb.* for October and November 1956

Materials	*Total p'd'n first 11 mos. of 1956‡*	*Total sales first 11 mos. of 1956‡*
Cellulose plastics:[a]		
Cellulose acetate and mixed ester		
Sheet, under 0.003 gage	17,762	17,976
Sheets, 0.003 gage and over	15,150	14,983
All other sheets, rods, tubes	6,788	6,549
Molding, extrusion materials	84,292	82,926
Nitrocellulose sheets, rods, tubes	4,958	4,541
Other cellulose plastics	5,179	4,658
Phenolic and other tar-acid resins:		
Molding materials[a]	199,013	176,763
Bonding and adhesive resins for:		
Laminating (except plywood)	58,626	41,384
Coated and bonded abrasives	13,929	14,664
Thermal insulation	52,396	51,126
Plywood	41,204	33,303
All other bonding uses†	48,012	45,560
Protective-coating resins	27,145	23,513
Resins for all other uses	32,389	28,050
Urea and melamine resins:		
Textile-treating resins	37,991	36,001
Paper-treating resins	22,646	21,302
Bonding and adhesive resins for:		
Plywood	94,906	88,534
All other bonding and adhesive uses, including laminating	23,046	21,734
Protective-coating resins	34,102	25,692
Resins for all other uses, including molding	80,215	78,087
Styrene resins:		
Molding materials[a]	402,435	363,030
Protective-coating resins	84,258	82,469
Resins for all other uses	94,689	96,344
Vinyl resins, total[b]	679,617	660,047
Polyvinyl chloride and copolymer resins (50% or more polyvinyl chloride) for:		
Film (resin content)		72,234
Sheeting (resin content)		51,608
Molding and extrusion (resin content)		188,427
Textile and paper treating and coating (resin content)[c]		57,495
Flooring (resin content)		59,574
Protective coatings (resin content)		25,846
All other uses (resin content)		64,796
All other vinyl resins for:		
Adhesives (resin content)		34,136
All other uses (resin content)		105,854
Coumarone-indene and petroleum polymer resins:	227,932	224,515
Polyester resins:	66,877	59,385
Polyethylene resins:	506,961	464,793
Miscellaneous:		
Molding materials[a,d]	39,658	37,213
Protective-coating resins[a]	10,378	5,137
Resins for all other uses[f]	108,300	100,186

*Dry basis designated unless otherwise specified. †Revised.
‡Partially estimated. ¶Includes friction materials.
[a]Includes fillers, plasticizers, and extenders. [b]Production statistics by uses are not representative, as end use may not be known at the time of manufacture. Therefore, only statistics on total production

Production

From statistics compiled by the U. S. Tariff Commission

October†		November‡	
Production	*Sales*	*Production*	*Sales*
1,539	1,505	1,448	1,581
1,621	1,633	1,379	1,426
676	586	548	548
9,390	9,575	9,291	8,931
396	379	365	366
564	546	551	481
17,971	16,433	15,235	15,257
5,930	4,410	5,250	3,842
1,450	1,652	1,278	1,493
5,063	4,850	5,732	5,356
3,808	3,192	4,777	3,943
5,150	5,161	4,416	4,392
2,711	2,070	2,616	2,053
4,121	3,317	3,456	2,824
3,442	3,577	3,355	3,224
2,216	2,035	2,279	2,424
9,077	8,412	9,284	8,371
2,437	2,508	2,215	2,032
3,481	2,889	3,914	2,914
8,518	8,348	7,136	8,018
37,735	35,035	35,539	31,515
8,110	7,434	7,087	6,555
11,054	11,832	8,928	9,940
67,176	70,992	65,900	65,934
	8,581		7,002
	5,341		4,774
	21,339		19,895
	6,384		5,888
	6,790		6,253
	2,568		2,639
	5,984		6,128
	3,231		3,115
	10,773		10,242
21,444	21,971	21,269	20,697
6,473	6,169	6,542	5,869
49,110	45,783	51,421	48,061
3,917	4,349	4,154	4,220
1,115	510	1,335	579
9,446	9,645	9,823	9,791

are given. *Includes data for spreader and calendering-type resins. †Includes data for acrylic, nylon, and other molding materials. *Includes data for epichlorohydrin, acrylic, silicone, and other protective-coating resins. ‡Includes data for acrylic, rosin modifications, nylon, silicone, and other plastics and resins for miscellaneous uses.

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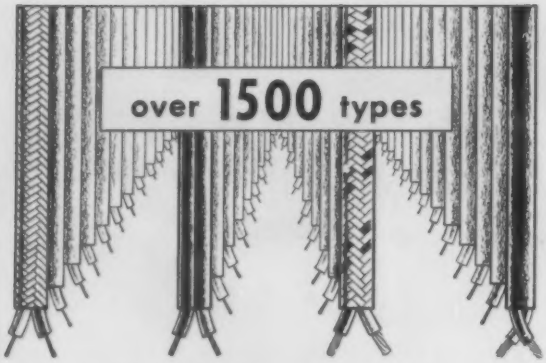

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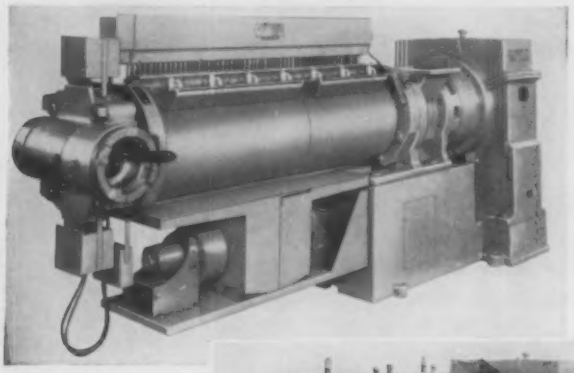

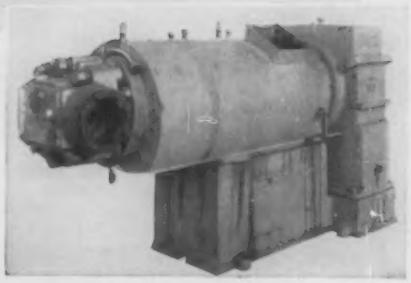

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If you are operating an older type Royle extruder you should investigate up-grading to Spirod—the electrically heated extruder with high velocity evaporative cooling—for maximum efficiency in controlled operating temperatures.

Write for Bulletin # 463

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Colored epoxy alloys

Epoxy resins may now be alloyed with appropriate colored curing agents to obtain an attractive selection of colors in the end product. This development marks one of the first steps toward the introduction of the versatile epoxy resins in decorative as well as industrial applications. The new colored curing agents have been prepared with safety hardeners which have been established as non-dermatitic in character. These colored safety hardeners have been specifically developed for utilization with a proprietary group of epoxy resins identified as "Epocast."

Although the introduction of colors to epoxy laminating and casting resins heralds their transition to more colorful fields of application, other innate advantages accrue:

1) As a quality control measure, the mixing of colored safety hardeners with epoxy resins makes it possible to be sure that the curing agent has been added and has been properly mixed and distributed.

2) The color coding of industrial castings and laminates offers eye appeal as well as functional diversification. Take, for example, power transmission poles and crossarms where appropriate color coding would not only be indicative of the presence of high voltages but would also be livelier in appearance than the prosaic browns and grays of weathered wood. The pattern industry, now beginning to accept epoxy resins, also has definite ideas for color coding of pattern components. Other manufacturers may identify or date their products through color coding.

3) "Solid" colored castings or laminates have obvious advantages over surfaces which have been decorated by coatings.

4) With an assortment of colored safety hardeners a manufacturer need only specify or stock one resin rather than a multiplicity of compounds. Because the curing agents that have been developed will permit good latitude of variation, color shades may be varied at will.

The technical qualities of the colored safety hardeners are described in Table I, which also lists the color coding and comparative viscosities. In all instances, stoichiometric proportions for an epoxy resin with an epoxy equivalent of 0.49 to 0.52 lie in the range of 18 to 21% addition of curing agent.

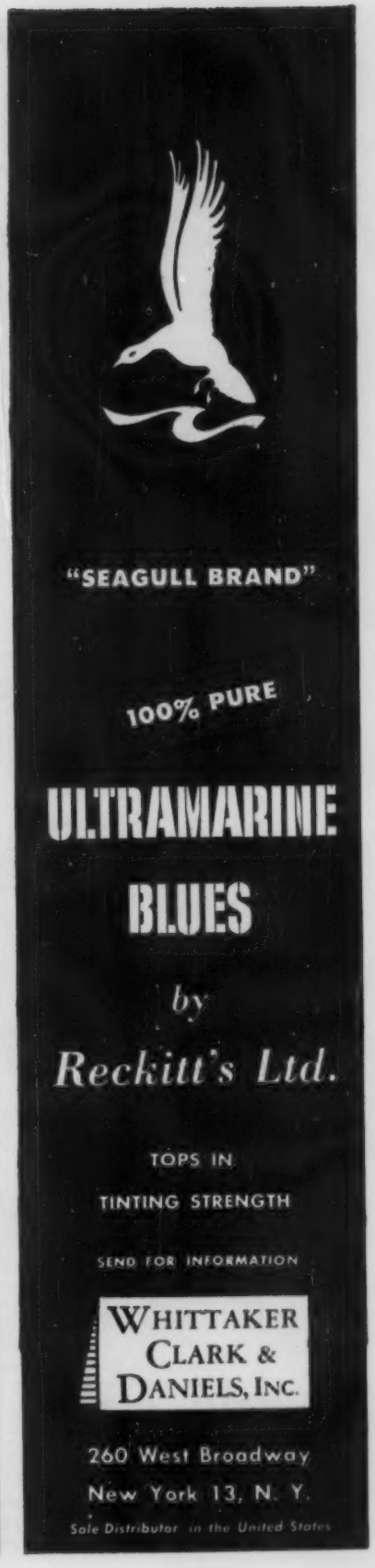
In practice, the colored curing agent is mixed into the epoxy resin. Streaks and striations would be indicative of improper mixing of hardener and resin which may be due to: 1) insufficient time of mixing; 2) sides and bottom of containers not thoroughly scraped and stirred in with the hardener; 3) material entrapped in pouring spout not mixed.

An inspector can readily find soft spots in epoxy castings and laminates by looking for the colored imperfections. In consequence, visual inspection now becomes an important adjunct to good quality control.—*John Delmonte, General Manager, Furane Plastics, Inc., Los Angeles, Calif.*

Table I: Colored epoxy curing agents[1]

Colored curing agent	*Viscosity at 75°F.*	*Light fastness*
Hardener 9810 — Neutral	500 to 700 cps.	Good
Hardener 9810-10 — Blue	600 to 1000 cps.	Excellent
Hardener 9810-20 — Yellow	600 to 1000 cps.	Excellent
Hardener 9810-30 — Red	600 to 1000 cps.	Good
Hardener 9810-40 — Black	600 to 1000 cps.	Excellent
Hardener 9810-50 — Orange	600 to 1000 cps.	Excellent
Hardener 9810-60 — Green	600 to 1000 cps.	Excellent

[1]Formulated for "Epocast 4-B" Casting Resin and "Epocast 2-D" Laminating Resin.



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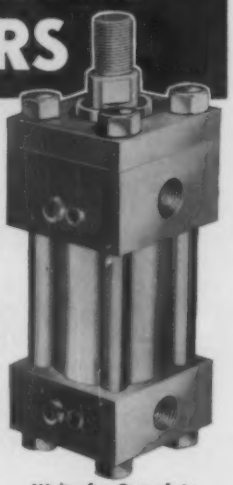

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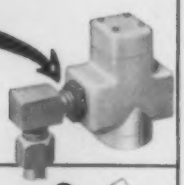

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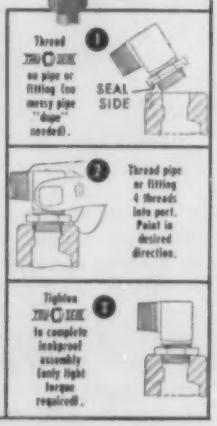
1
Thread TRU-O-SEAL on pipe or fitting (no messy pipe "dope" needed).
SEAL SIDE
2
Thread pipe or fitting 4 threads into port. Point in desired direction.
3
Tighten TRU-O-SEAL to complete leakproof assembly (only light torque required).

Colorful polyester-glass hood for outboard motor easily snaps into place

Motors in color

In line with increasing public awareness of color as an integral part of product design, even in such areas as boating accessories, Scott-Atwater Mfg. Co. is now supplying the reinforced plastics hoods for its redesigned new outboard motors in a wide range of colors.

Boat owners can now match up the color of the motor with the color of the boat—and, because the hoods are held snugly in place by a set of metal clips at the base, they can be snapped off and snapped on again in a matter of seconds when the boat owner wishes to make a change in the color scheme.

In addition to their decorative features, the polyester-glass laminate hoods contribute to the efficient operation of the motor. They are light in weight, extremely rugged, easy to maintain, colorfast, and resistant to corrosion even after constant exposure to salt water. The hood also serves to dampen the noise of the motor in operation.

The reinforced plastics hoods are available for the 40-, 16-, 10-, and 7½-hp. units in a choice of five integral colors—red, white, mahogany, blue-green, and grey. The entire line of motors was styled by Raymond Loewy Assoc., Inc.

Credits: Reinforced plastics hoods molded by Industrial Products Div., The General Tire and Rubber Co., Marion, Ind., and G. B. Lewis Co., Watertown, Wis.

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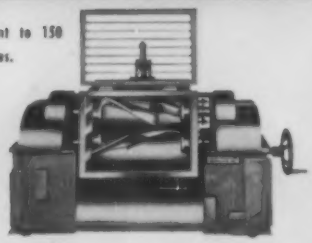

#41L–10 Gal. Double Arm Kneader with two speed brake motor. Jacketed trough and motor-operated lift optional.

• 4½ x 10, 6 x 14, 9 x 24, 12 x 30, 14 x 32, 16 x 40" sizes.

#32TC–14" x 32" High Speed Three Roller Mill. Hydraulic adjustment and pressure recording gauges optional.

#30C–50 Gal. Heavy Duty Change Can Mixer. Adjustable outer scraper, cover with charging port, and gates on cans optional.

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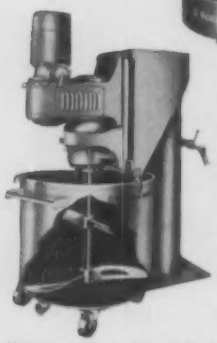
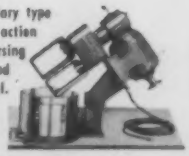


#130H–250 Gal. Change Tank Mixer with hydraulic raising and lowering and variable speed motor. Various type stirrers and high speed impellors optional.

• 80,150 and 250 gal. sizes.

#130EL–1 Gal. Double Planetary type Change Can Mixer with shearing action stirrers, and variable speed reversing type motor. Jacketed cans and portable trucks for cans optional.



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Film is placed over reinforcing rods preparatory to pouring a concrete roof without use of conventional forms

Concrete roof on polyethylene film

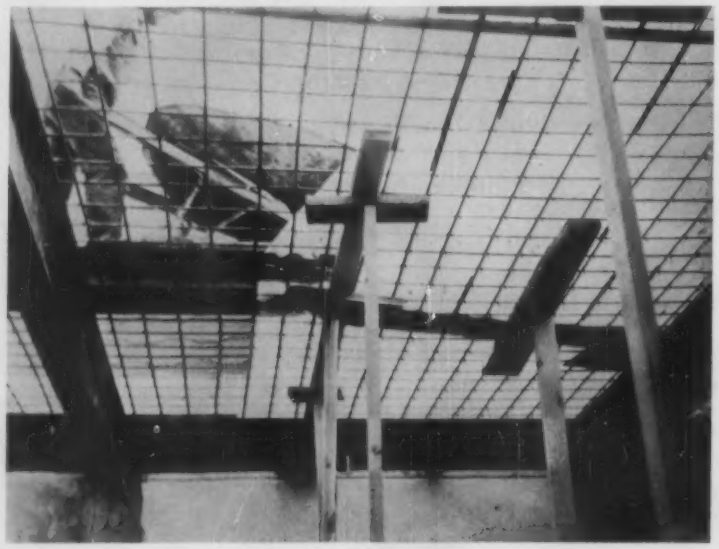
Polyethylene film laid over reinforcing rods and, in turn, covered with standard reinforcing mesh, permitted the recent installation of a 72- by 24-ft. concrete roof without the use of conventional and expensive forms to hold the concrete.

The combination of polyethylene film, rods, and mesh easily withstood the weight of the concrete. The roof is supported by 16 strategically placed I-beams, spaced 8 ft. on centers. On these beams were placed ⅜-in. reinforcing rods laid at intervals of 6 inches. These rods supported other ⅜-in. rods placed parallel to the I-beams, also at intervals of 6 inches.

Six-mil polyethylene film was then laid across the reinforcing rods, and the standard reinforcing mesh was placed on the film. Following this, premixed concrete was poured directly on to the film. When the concrete set, temporary braces were removed.

Credits: Visqueen polyethylene film is manufactured by The Visking Corp., Plastics Div., Terre Haute, Ind.

Temporary planking protects polyethylene film; temporary braces will be removed after concrete has set



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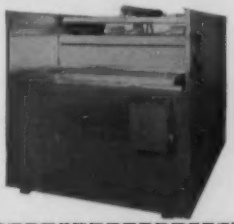

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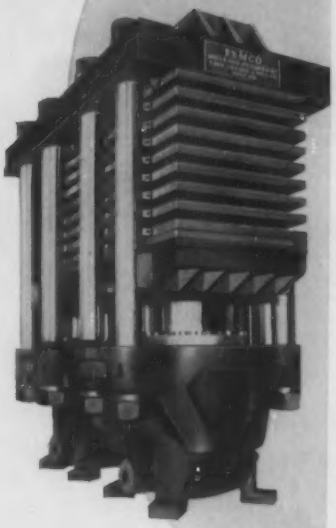

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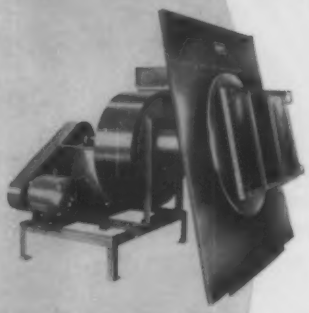

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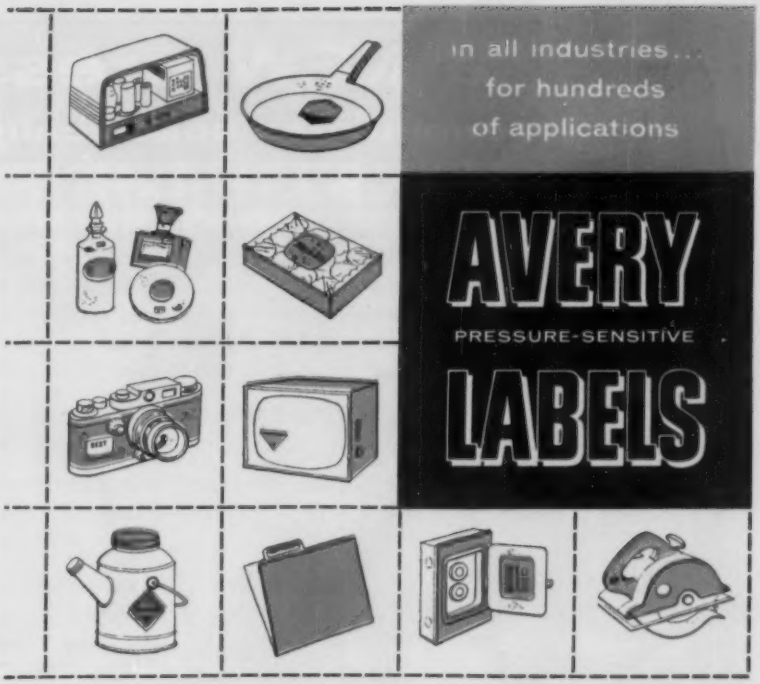
Now, not only is the corrosion problem eliminated, but the acetate clamps have proved superior to their metal counterparts from the standpoint of durability and ease of installation. The copper clamp, flimsy and easily twisted out of shape because it is made of thin metal, costs more than the acetate clamp. The acetate clamp has good heat resistance and rigidity and should find many applications in the refrigeration piping, electrical, and plumbing industries.

Molded-in undercuts make it possible to press the clip on to the pipe where it holds firmly while the unit is nailed in place. The ½- and ¾-in.-size clamps, molded in a 24-cavity mold on an 8-oz. press, can be used on hot or cold lines and, because of their high degree of resiliency, will not crack when the pipe expands or contracts with changes in temperature.

Credits: Clamps are molded by The General Industries Co., Elyria, Ohio; Hercocel A acetate supplied by Hercules Powder Co., Wilmington, Del.

Molded acetate pipe clamp clips firmly onto pipe



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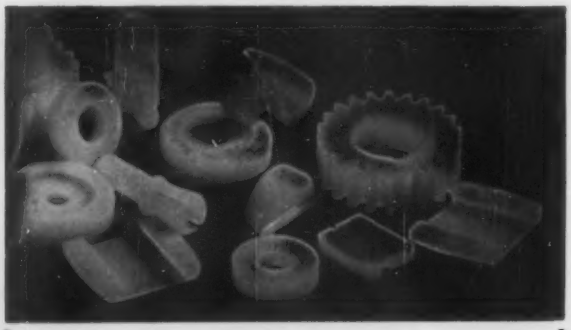

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Note: Nylon rivet shown molded for Illinois Tool Works

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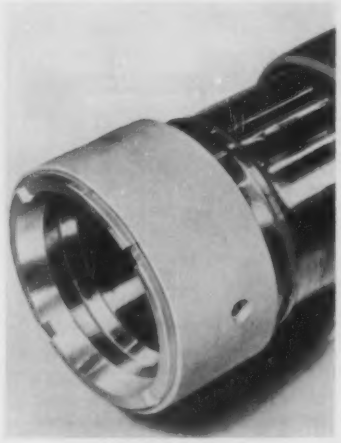
The pistons, original design of which was conceived by the Cleveland Pneumatic Tool Co., Cleveland, Ohio, to meet the need for a product that could withstand the severe service requirements of shock-absorbing struts in aircraft landing gear, are made from aluminum cylinders to which the thermosetting plastic is bonded by a special cladding process.



Close-up of laminate-clad piston and bearing

In this technique, a continuous sheet of cotton fabric impregnated with a phenolic resin is wrapped around the knurled surface of a cylinder of 2024-T4 aluminum until the desired thickness is obtained. The resin is then polymerized under heat and pressure to produce a solid plastic sleeve securely bonded to the aluminum cylinder.

Since the pistons cannot be attacked by lubricants or hydraulic fluids, corrosion is, of course, eliminated.

Credit: Laminate supplied by Synthane Corp., Oaks, Pa.

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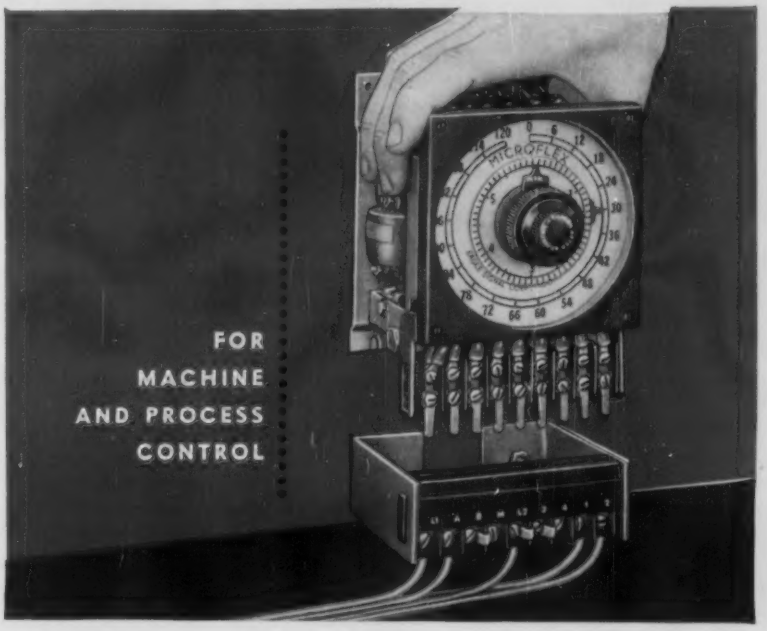

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Plastics on West Coast

(*From pp.* 123-125)

imately 5000 will be manufactured in the West. Since boats cannot be economically produced and shipped several thousand miles, several of the major western boat producing companies are invading other areas of the country with branch production facilities. This type of dynamic marketing is typical of the whole western reinforced plastics industry. Producers of luggage, furniture, swimming pools, and sports car bodies are at the same level and in many cases considerably farther ahead of the rest of the country in engineering ability, production know-how, and distribution facilities.

In the thermoplastics field, western housewares are an important part of the plastics economy, accounting for approximately 15% of the nation's production. More and more of these housewares are showing up in other areas of the country, where Western styling and design are becoming appreciated.

The production of plastics toys on the Coast is not huge in terms of national consumption, but the individual companies involved have developed highly specialized and highly successful operations which have resulted in national distribution. Indeed, western plastics toy makers have literally been forced to build plants in the East and Midwest so that they can better serve demands that have been created by their quality and their design.

Automobiles and appliances

Despite the tremendous population growth, the automobile and appliance industries are not established on the Coast as users of locally produced plastics components. The production of automobiles in California, for example, is only about half a million cars a year and the parts are generally shipped from the Midwest. In the case of home appliances and refrigerators, they are generally shipped complete for sale on the Coast. Some people in the industry feel that this situation is bound to change because of high freight cost and that Pacific Coast

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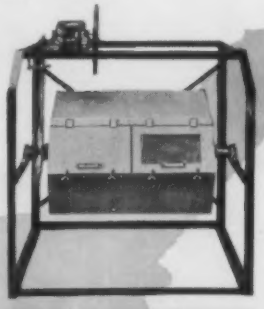

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assembly plants for these end-user industries will be built and will result in a greater use of western custom components. Population growth is cited as another potent reason for this belief.

Table II shows the extent to which the wesern states are self-sufficient in the matter of plastics processing—molding, extrusion, and fabrication. Estimated sales of products and parts in millions of pounds are given in the left-hand column while the percentage of each material expected to be turned into products and parts in the West in 1957 is given in the right-hand column. This is a consensus of market research opinion from a large sampling of material makers.

Expansions, mergers, new plants

The extent to which the Far West is likely to become more self-sufficient from the standpoint of materials production is less predictable, but significant are the following examples: Tripling of polyurethane foam capacity by American Latex Products Corp., Hawthorne, Calif.; Avery Adhesive Label Corp.'s new half million dollar plant extension at Monrovia, Calif.; Borden Co.'s purchase of Resin Industries, Santa Barbara, Calif., and its decision to build a pentaerythritol plant at Dominguez, Calif.; Brea Chemicals' Inc., Div. of Union Oil Co. of Calif., announcement that it will produce polyolefin plastics for national distribution; Carbide and Carbon Chemical Corp.'s bringing on stream a new high-pressure polyethylene plant at Torrance, Calif., 60-million-lb./yr. capacity; Dow Chemical Co.'s new styrene-butadiene plant in Pittsburgh, Calif.; expansion by Furane Plastics Inc., Los Angeles, Calif.; licensing agreement between W. R. Grace & Co. and Sequoia Process Corp., Redwood City, Calif., for the Hyrad process; Hexcel Products Co.'s, Oakland, Calif., entrance into the adhesive field through Adhesives Engineering; Interchemical Corp.'s expansion of finishes facilities in Los Angeles; Loven Chemical of Calif.'s enlarged phenolic facilities at Newhall, Calif.; Minnesota Mining & Mfg. Co.'s purchase of Zenith Plastics Co., Gardena, Calif.; Monsanto Chemical Co.'s enlargement of Long Beach, Calif., styrene molding powder facilities; Narmco's expansion at Costa Mesa, Calif.; Naugatuck Chemical, Div. of U. S. Rubber Co., to make Vibrin polyesters on the Coast; purchase by Portco Corp., Vancouver, Wash. of the Simpson Logging Co.'s Plastics Pipe Div.; Reichhold Chemicals Inc.'s addition of new resins to its lines produced at both San Francisco and Azusa, Calif.; expansion by Rezolin Inc. at Santa Monica, Calif.; acquisition by Stillman Rubber Co., Culvert City, Calif., of Tele-Muff Co., San Fernando, Calif.; Thalco's construction of a huge new warehouse and distribution center in Los Angeles.

The above does not purport to be a complete coverage of the expansion-merger-facilities construction picture; it is offered as an indicator of what has become a decided trend.—END

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CONTRACT MOLDING. Folder describes two-plant facilities and itemizes capital equipment of large Ohio compression, transfer, and injection molding organization. General Industries Company. (C-702)

SPRAY MASKS. 20-page brochure illustrates and describes wide range of spray masking devices and decorative effects possible. Also discusses accessory jigs and fixtures. Wm. M. Fiore Inc. (C-703)

FUSING AND DRYING MACHINES. Illustrated catalog describes company's line of curing, fusing and drying equipment for processing coated web stocks. Machines are suitable for fusing vinyl coatings, setting phenolics, drying coatings and lacquers, removing solvents. F. C. Dawson Engineering Company. (C-704)

INFRARED DRYING FOR LAMINATING. Illustrated report describes use of infrared oven for drying and curing resin-impregnated cloth or paper prior to laminating. Edwin L. Wiegand. (C-705)

LOW MOLECULAR WEIGHT POLYETHYLENE. 14-page technical bulletin describes company's low molecular weight polyethylene. Gives typical properties and discusses end uses. Allied Chemical & Dye Corp. (C-706)

REPLACEMENT PLASTICIZER. Technical bulletin provides test data and a typical-properties list for a plasticizer developed to partially replace DOP-DIOP types in products where water-white color is not required. Brown-Allen Chemicals Co., Inc. (C-707)

ELECTRONIC HEAT SEALER. Illustrated brochure describes and gives specifications for company's electronic heat sealer. Includes sample of intricate three-dimensional multi-color work produced on this machine. Cosmos Electronic Machine Corp. (C-708)

METALLIZED MATERIALS SWATCH-BOOK. Describes and gives samples of available patterns, colors and constructions of "Doray", a metallized polyester film bonded to various backings. Dorrie Process Company. (C-709)

ROLL LEAF. Folder contains sample swatches of gold and aluminum Mylar-backed leaf for hot die stamping. Includes prices. Ralph W. Grauert Inc. (C-710)

SURFACE PYROMETERS. Folder describes extensive line of surface pyrometers with a range of from 0 to 1200° F. Suitable for molds, calender rolls, plastic materials. The Pyrometer Instrument Company. (C-711)

ROTARY SAW BLADE. Folder describes rotary saw blade suitable for high-speed cutting all types of plastic sheet and laminated stock. Blades available in diameters from 8 to 16 in., feature reinforced tips for long wear. Radial Cutter Manufacturing Corporation. (C-712)

DRY COLORANTS FOR POLYSTYRENE, POLYETHYLENE. Brochure describes company's pre-lubricated dry colorants for polystyrene, high-impact styrene and polyethylene that can be used without wetting agents. Price list included. Riverdale Color Company, Inc. (C-713)

DRY COLORING. Folder suggests procedures and equipment to be used in the dry coloring of molding compounds. Information on company's line of colorants and dispersants is included. Plastics Color Company. (C-714)

INJECTION MOLDING EQUIPMENT. Folder summarizes company's 1956 developments in the manufacture of replacement heating cylinders, nozzles, drum tumblers, and part grinders for injection molding and mold releases, ovens, hoists, circulators. Injection Molders Supply Company. (C-715)

ELECTRONIC CONTROL SYSTEMS. Folder describes company's facilities for the production of custom electronic control systems, including a system for measuring weights or thickness of sheet material. Curtiss-Wright Corporation. (C-716)

ELECTRONIC HEATERS. Folder contains illustrations and descriptions of extensive line of induction and dielectric heaters. Contains specifications. Scientific Electric. (C-717)

FLEXURE AND COMPRESSION TESTER. Literature describes hydraulic machine that can be used for destructive and non-destructive flexure and compression testing of molded and reinforced plastic pieces. Includes illustrations and specifications. Soiltest, Inc. (C-718)

PLASTIC FILM PERFORATOR. Literature illustrates and describes rolls, cylinders, bars, tubing, shafts, and sections with pointed surfaces suitable for punching or perforating plastics film. Robert A. Main & Sons. (C-719)

RESINS FOR FOREIGN DISTRIBUTION. Literature prepared for foreign subscribers lists types of thermosetting, thermoplastic and cellulosic resins in company's line. Also discusses colorants for plastics. Interplastics Corporation. (C-720)

ANALYZING ODOR OF PLASTICS MATERIALS. Folder describes technique for evaluating odor of plastics and other materials by using a "sensory panel" of trained personnel. Evans Research & Development Corporation. (C-721)

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ELECTRICALLY HEATED EXTRUDERS. Folder contains illustrations, descriptions and specifications for extruder with length-diameter ratio of 20:1. Describes optional cooling system. Frank W. Egan & Company. (C-724)

PANEL SAWS FOR SIZING SHEET STOCK. Folder illustrates, discusses and provides specifications for several models of panel saws, power operated for sizing and trimming plastics. Hendrick Manufacturing Corporation. (C-725)

HIGH SPEED PRESSES. Folder illustrates hydraulic presses designed for operations where high closing speed and a comparatively short pressure stroke is desirable. Includes cross-section diagram and specifications chart. Davidson-Kennedy Company. (C-726)

INJECTION MOLDING MACHINES. Folders contain blue-print diagrams, descriptions, illustrations, and specifications for line of injection molding machines with 1.5, 2, 4, 6, 12, 22, 28 and 32 oz. capacities. Improved Machinery, Inc. (C-727)

NYLON MANUAL. 16-page booklet illustrates and describes applications and properties for line of nylon rods, strips, sheets, and tubing. Discusses fabricating techniques and special considerations for designing nylon parts. The Polymer Corporation of Pennsylvania. (C-728)

EPOXY PLASTICIZERS FOR VINYL RESINS. 28-page technical booklet charts performance data, compatabilities, and properties of three epoxy plasticizers that also possess stabilizing functions in vinyl resins. Archer-Daniels-Midland Co. (C-729)

EXPANDED FOAM POLYETHYLENE. Illustrated data sheet contains graphs of tensile strength and water absorption for an expanded foam polyethylene. Density can be made to vary from 10 to 50 lbs per cubic foot. Includes properties chart. American Agile Corporation. (C-730)

USES OF EXPANDED POLYSTYRENE. Illlustrated booklet describes expanded rigid polystyrene, suitable as an insulating material at temperatures below 175° F.; as a buoyancy material and a packaging substance. Includes discussion of properties. The Dow Chemical Co. (C-731)

POLYETHYLENE INFORMATION BOOKLET. 12-page booklet contains general discussion in non-technical terms of the uses, physical composition, development, processing and fabrication of polyethylene, including applications and properties of company's polyethylene resins. U. S. Industrial Chemicals Company. (C-732)

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SAWING AND GROOVING PLASTICS SHEET. Illustrated 12-page catalog describes and gives specifications for a machine used for sawing, grooving, and multiple cutting of plastic sheet. Describes accessory equipment suitable for many fabricating operations. Mereen-Johnson Machine Company. (C-735)

STEAM GENERATOR. Folder illustrates and describes line of steam and hot water generators with outputs of 603,000 to 16,750,000 BTU per hour. Cyclotherm Division, National-U.S. Radiator Corp. (C-736)

COMPRESSION MOLDING PRESSES. Catalog folder illustrates, describes and provides general specifications for automatic 60 and 100 ton compression presses. Also illustrates and describes powder feeder and loader. Baker Brothers Inc. (C-737)

GAGES FOR SHEETING. Illustrated folder describes control equipment for continuously measuring the thickness of sheet material by non-contact x-ray or beta ray operation. Also describes totalizers for measuring number of feet of strip being rolled. Pratt and Whitney. (C-738)

REINFORCED MOLDING COMPOUNDS. Folder charts characteristics and properties for asbestos, cotton-filled, fibrous-glass reinforced phenolic and melamine molding compounds. Includes illustrations of applications. Fiberite Corporation. (C-739)

CUSTOM MOLDER FOR SHORT-RUNS. Booklet illustrates and describes Minnesota custom molding firm's work with thermoplastics and thermosets in the production of short-run molded plastics. Dayton Rogers Manufacturing Co. (C-740)

MIXER-PUMP FOR RESINS. Literature describes unit that automatically measures, mixes, and pumps mixed materials such as two parts resins at an ejection rate of 1 to 72 shots a minute. H. V. Hardman Co., Inc. (C-741)

INJECTION PRESSES. Illustrated folder contains detailed specifications for a 12-16 oz. capacity injection press and a 16-20 oz. model. Includes blueprint-diagram of machines. Lombard Governor Corp. (C-742)

PLASTICS MATERIALS. 36-page brochure discusses properties and applications for polyeseter resins, vinyl resins, and high-impact resin-rubber blends, and plasticizers produced by company. Also discusses company's rubber and agricultural chemicals. Naugatuck Chemical. (C-743)

EXTRUDERS. Illustrated folder contains specifications for line of extruders with 2½, 3½, 4½, 6, and 8 in. screw diameters. Also illustrates and discusses automatic temperature control unit. Prodex Corporation. (C-744)

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EXCEPTIONAL LIGHT STABILITY

Tests prove that films containing Conoco H-300 show light resistance equal to, or better than, those with no extenders—a unique contribution in the field of secondary plasticizers.

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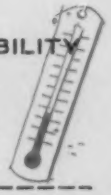

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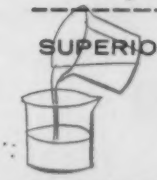

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Mixtures containing Conoco H-300 have appreciably lower initial and aged viscosities.

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Can save the processor as much as 2 cents per pound on the finished product. Conoco H-300 can be used to the extent of 25% of the total plasticizer required.

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Formulations are more readily mixed because of fast wetting and internal lubricating properties.

In view of these advantages it will pay you to reanalyze your needs.

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CONTINENTAL OIL COMPANY

Mass produced

(*From pp. 126-128*)

curate for quality control. Many different types of pumps were tried and rejected before the proper design was selected.

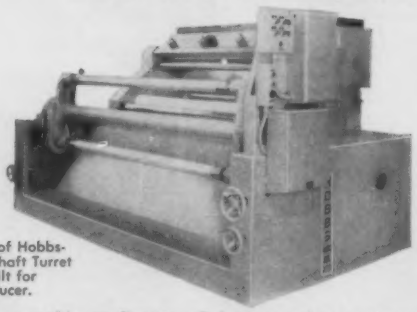
As the pans on the endless belt move under the traversing mixing head, polyurethane commences to foam immediately. At normal speeds a full 10-in. blow is achieved at one end of the pan by the time the following pan passes under the head in turn. After approximately 6 ft. of travel, the pan enters a curing chamber where it travels 20 ft. before entering the oven heated by electrical elements equally spaced top and bottom to maintain a temperature of from 200 to 240° F., depending upon density. The pans remain in the oven approximately 5 to 8 min. before emerging into the processing room. The slabs are removed from the pans and immediately weighed and graded. Pans are again treated with the parting agent, placed on another conveyer, and reheated to a temperature of 85 to 90° F. before again registering under the mixing head.

During this sequence nearly a score of critical operations must be held to precise limits; a slight variation in any one of them can ruin the entire blow. Consequently, the engineers have developed a control system that, while not technically "automated," provides nearly automatic operation. Only one semi-skilled man is required for supervision once controls are set. These include storage tank pressure and temperature regulators, tachometer control pumps and mixing head traverse speed, electronic head speed monitoring, water polution warning, mixing head ratiometer and viscosity meters, as well as oven temperature thermostats. Quality control is maintained by checking periodically with test samples obtained in paper cups. These samples are permitted to achieve full blow height and one-half gel. At this point the operator can easily break off the top of the sample for a cell size check.

On the other hand, production of polyurethanes requires a degree of control which can be achieved only by careful safety procedures. Vapors generated during the blowing stage are highly toxic. Injurious quantities of gas can be produced even by small amounts of spillage, requiring more than adequate ventilation. At Alpco, each man working on the polyurethane production lines is required to undergo a complete physical examination and blood check before employment and every 90 days during the period he works in the area.

Latest change in this polyurethane production setup has been the development of a mechanical process that permits blowing an endless 6-ft. by 10-in. wide strip. This is accomplished by the use of pans without end pieces and with folding hems at the sides. Plans now call for the installation of a special saw that automatically will cut strips into 50-in. lengths, horizontally cut the material into thicknesses of from 1/16 in. to 2 in., and then roll and stack it.—END

Winding AFTER EXTRUDING
AS ENGINEERED BY
HOBBS-ALQUIST



Side view of Hobbs-Alquist 2 Shaft Turret Winder built for resins producer.

Here is a graphic application of how *complete* engineered winding after extruding can be when engineered by Hobbs-Alquist. At the plant of a leading resins producer a Hobbs-Alquist Winder installation is engineered to handle plastic film heat treating and slitting, then turret wind the material and take care of trim disposal . . . all tied into a previous process to make continuous operation a swift, sure, economical fact.

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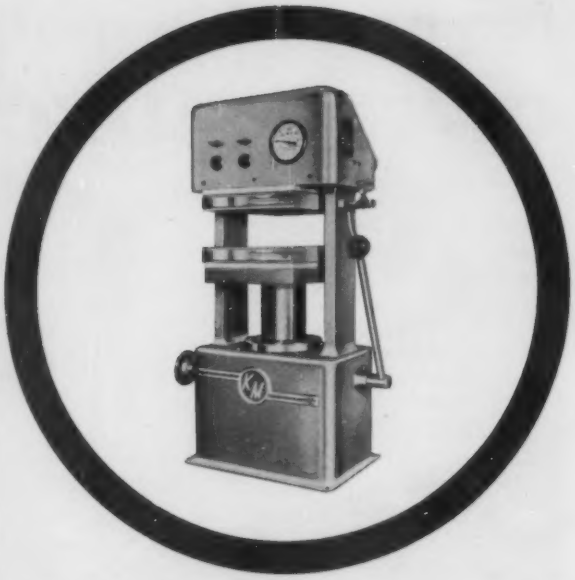

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A case for quality

(From p. 137)

styrene alloy. On the more expensive of the two models the motor board is designed with an integral front-inclined speaker grille for better sound reproduction. Cored bosses molded in the base section of the sisal-phenolic cases provide attachment and assembly of the motor boards by means of thread cutting screws. Molding of the cases as well as the motor boards is performed by Admiral at its Molded Products Div. plant in West Chicago, Ill.

Admiral's selection of the sisal-phenolic material for these cases was based upon its relative economy, coupled with the sturdiness and abrasion resistance of the finished parts. The molding material itself is prepared in the Molded Products plant and used as required. The dry ingredients, including chopped sisal, mold release agent, short asbestos fibers, and the above-mentioned extender are preblended in a Baker-Perkins sigma blade mixer having a steam heated jacket. After the preblending operation, liquid phenolic resin is added and mixing continued to advance the material to the proper stage. The molding material is then cooled and stored in covered drums.

At the time of molding, the material is weighed out and preheated. Weighed charges are then placed in the center of two-cavity semi-positive family molds which produce the top and bottom sections of a complete case. The molds, which are run on a 750-ton compression press, have side cores which form ventilation openings and mounting holes for hinges, handles, and latch components in the sidewalls of the molded parts. The molding cycle is approximately 2¼ min. at a temperature ranging from 330 to 340° F.

Upon removal from the press, the parts are rough-flashed by the operator and placed in metal shrink fixtures to insure accurate alignment and fit of the mating parts. Case components requiring color receive a two-coat system of epoxy-based paint. Each coat gets a ½-hr. bake at 272° F. The cases are ready for assembly and installation of the motor board, turntable, and tone arm of the record player. Hinges, handles, and latches are mounted to the cases by means of metal rivets.

In addition to its use in phenolic molding compounds, the new fir bark material is employed as an adhesive extender for plywood and other industries and as an extender for thermoplastic resins. It is available in unlimited quantities.

Credits: Liquid phenolic resin, Acme Resin Corp., Forest Park, Ill., and Bakelite Co., New York, N. Y. Chopped sisal reinforcement material, Plymouth Fibres Co., Inc., Brooklyn, N. Y., and R. L. Pitchard Co., New York, N. Y. Asbestos fibers, Johns-Manville, New York, N. Y. Silvacon No. 412 processed Douglas Fir bark resin extender, Special Products Div., Weyerhaeuser Timber Co., Tacoma, Wash. Heat resistant high impact styrene material for motor boards, Styrene 440, Dow Chemical Co., Midland, Mich.

Filament winding

(*From pp.* 132-133)

while still in its infancy, has already been put to important use. Photographs herewith show a variety of structures typical of those fabricated by filament winding. Design criteria for such structures have been carefully studied and are constantly being improved. By the use of suitable liner materials, filament-wound structures have been employed as pressure containers for various gases and liquids, e.g., air, oxygen, helium, nitrogen, nitric oxide, and liquid fuels.

Typical of such pressure vessels are those recently employed by the Air Force Cambridge Research Center for containing nitric oxide gas at a pressure of 3000 p.s.i. These were mounted in an Aerobee rocket for the upper-atmosphere investigations conducted by the Center. Another recent development is a glass-reinforced plastics fuel expulsion tank which employs a special rubber diaphragm made integral with the liner material. This tank is designed to contain a jet fuel which may be rapidly expelled by pressurizing with an inert gas from the opposite side of the diaphragm. Currently, glass filament-wound structures are being developed for service at temperatures above 200° F.

Has varied uses

The versatility of the filament-winding techniques is demonstrated in such structures as the precision - wound 1½ - in. - O.D. glass-reinforced plastics pressure spheres which required close, reproducible dimensional tolerances; and the igniter baskets (see lower center of picture on p. 132) which have been fabricated in various sizes and shapes for containing pyrotechnic igniter pellets for initiation of rocket firings. These are currently being manufactured in large quantities.

To date almost all applications of filament winding have been for the missiles and aircraft fields. But the same economies, strength factors, and form versatility are expected soon to bring these techniques into use in consumer and industrial products.—END

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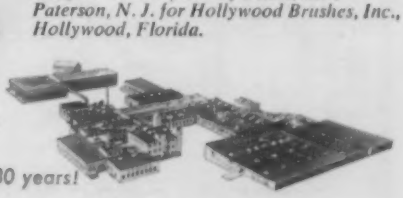
Nail brush with bristles, molded complete in one piece by Britel, Inc., Paterson, N. J. for Hollywood Brushes, Inc., Hollywood, Florida.



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Plastics steal

(*From pp.* 141-143)

of almost any density required. They may make possible entire motion picture sets cast or spray-foamed in one piece.

Although still inexpensive, polyurethanes are now generally available, and greatly reduced prices are expected as higher production is reached. Even today the end products are considered economical in the movies because of simple application and light weight. Limited use of them has already been made.

As time goes on, not only such newcomers as polyurethanes, but literally hundreds of similar new plastics stars will continue to be tested by Hollywood cine laboratories. And tomorrow's engineers in general industry may begin to look to—and find their answers in—today's little-known but successful motion picture applications of plastics.

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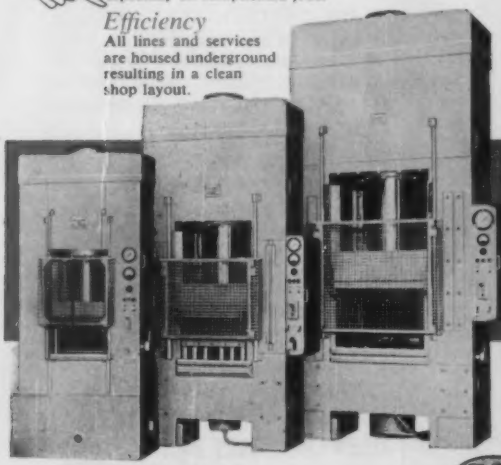

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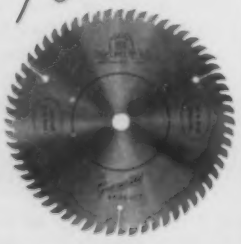

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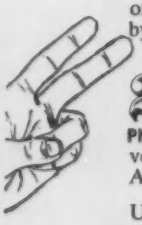

2 For a low-cost replacement for n-Octyl n-Decyl Phthalates where low temperature and low volatility are desirable, look into BROWN-ALLEN Polycon #5B.

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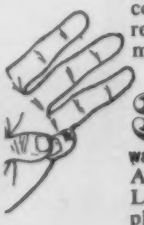

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B-A

Membrane molding

(*From pp.* 144-145)

table herewith, show a glass content of 70% by weight. The properties are typical and, to the best of our knowledge, cannot be duplicated in a pressed part. Comparable glass-resin ratios are possible under high pressures in a press, but there is grave danger of fracturing the glass fibers, and physical properties are often disappointing.

This combination of high density, high glass content, and high physical properties in a low-pressure part is probably a result of the fibers in the glass cloth being "persuaded" into a nested position by mechanical working as the laminator scrapes the excess resin out of the layup. Pressure under the scraper lip is probably 200/300 p.s.i., but this is a local pressure on relatively unrestricted fibers. The operation proves to be much less destructive to fibers than the brute force of over-all pressure exerted by a die. Once "nested," the low pressure provided by vacuum is sufficient to maintain the position during gelation.

Thin parts, dimensional stability

This offers an advantage in thin parts which require dimensional stability. An example would be a parabolic reflector having a thickness of about 0.030 in. and a diameter of about 2 feet. It is provided with a stiffening ring but it is mounted from a fairly small central area, the remainder being unsupported. It is a critical electronic application and warping is very undesirable. Apparently this is a part which lends itself admirably to matched metal dies. The shape is symmetrical and tool making is a relatively inexpensive lathe operation. Yet the parts produced on dies showed excessive warpage, even with isotropic orientation of the cloth layers. Identical membrane molded parts, on the other hand, show no perceptible warping.

The reason for this is the fact that it is impossible to close metal dies on the layup without some movement of the glass cloth. Thus the fibers are held in slightly deformed position during cure. The

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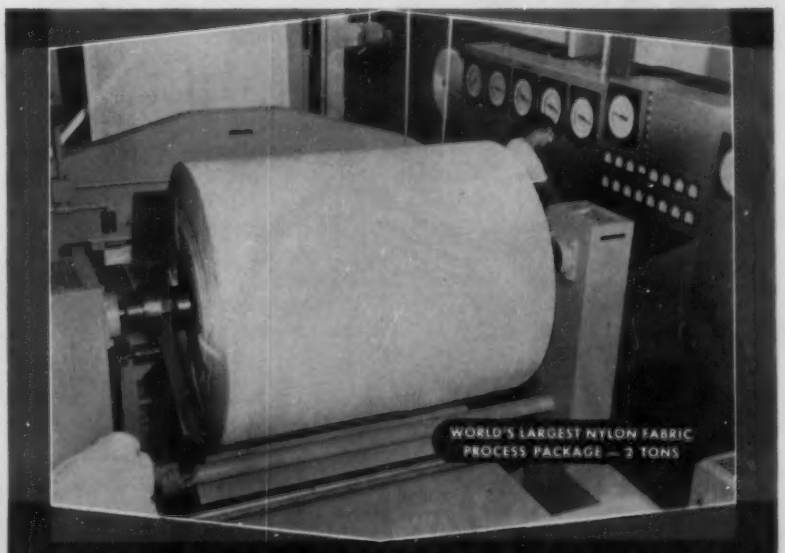

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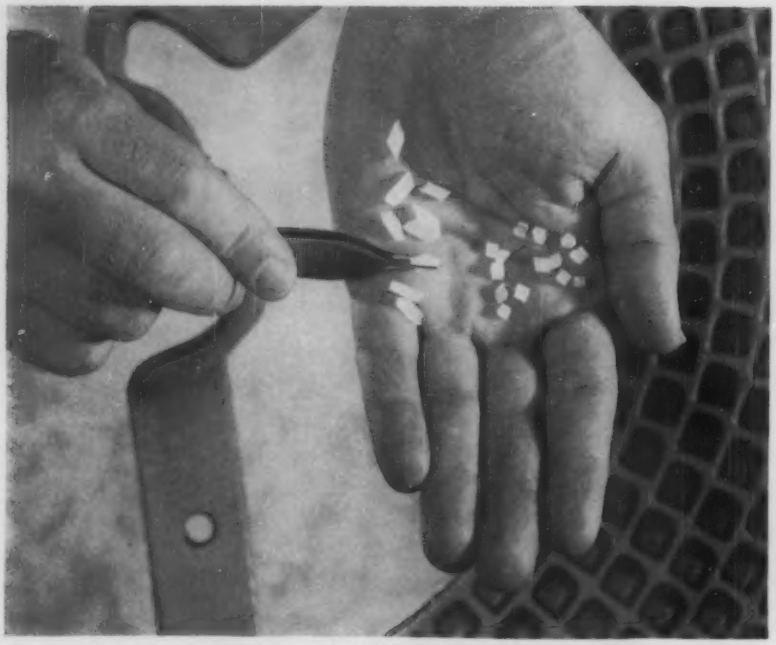

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part leaves the die with residual stresses which, when relieved, cause deformation. In contrast, the membrane cannot deform the cloth in any way. After being nested by the scraper, the glass fibers are free to assume an inherently stress-free condition. No stresses are "built in" and the resulting part is dimensionally stable.

These are representative of some of the unique advantages of membrane molding. Some other factors may be considered briefly.

Uniformity is consistently maintained to the degree required, for example, for interchangeable aircraft and electronic parts.

Gage thickness tolerance is normally about ±10% but ±5% has been held over critical areas when necessary.

Surface finish is excellent.

Tooling is simple. Tool cost is usually a small fraction of the cost for equivalent metal dies. The tooling may be duplicated at low cost as required to increase production rates. Tooling lead-time is very short as compared with other methods. Ten to thirty days (depending on complexity) from drawing to finished part is not unusual.

Versatile method

Generally speaking, membrane molding has been most fully developed in connection with the low-viscosity resins such as polyesters and epoxies. However, with the higher pressures provided by an autoclave, it can be adapted to the phenolics and silicones.

Proper design is very important to best use of the process so that it is necessary for the fabricator to maintain an unusually complete customer consulting and liaison service. Some parts lend themselves ideally to membrane molding; some are not suitable for the process; most require minor modification if full advantage is to be taken of the possibilities.

Membrane molding is steadily gaining a secure place in reinforced plastics fabrication, not so much because it competes directly with other processes, but because its unique advantages create new possibilities for the use of the materials.—END

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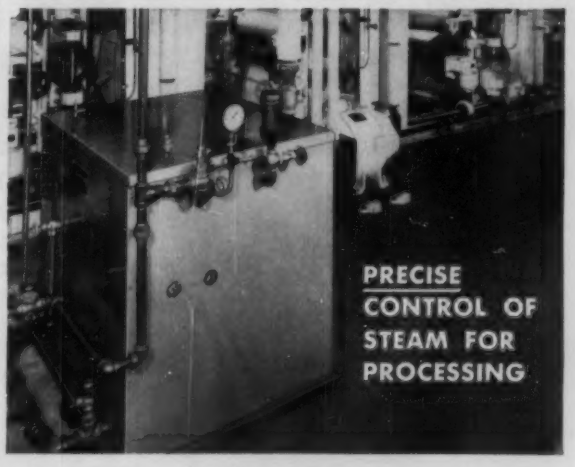

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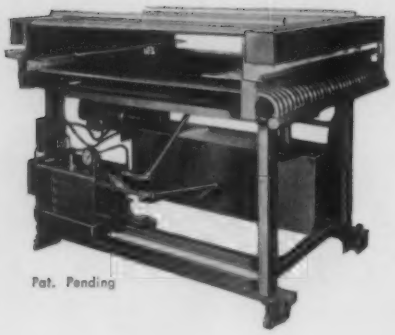

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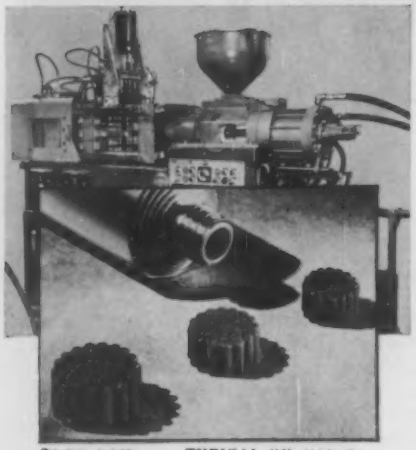

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SINCE 1918

Pacific Coast

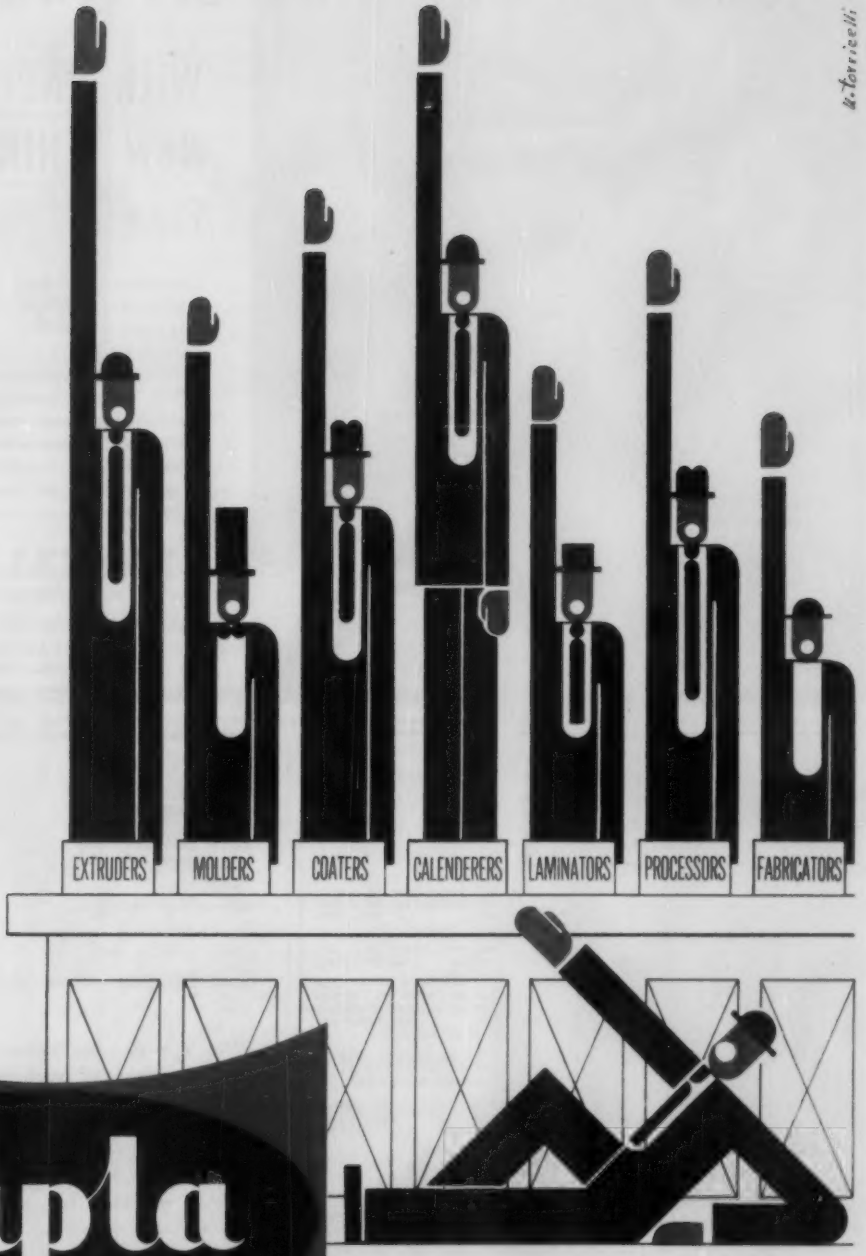
(*From pp. 154-158*)

pound suitable for molding attractive trays (photo p. 154), bowls, and other serving pieces for either home or commercial use.

As indicated above, the presence of the aircraft industry on the West Coast has stimulated interest in reinforced plastics processing—and a number of outstanding products based on the material are now coming out of this area. The matched molded reinforced plastics luggage of H. Koch & Sons, Los Angeles, is already being distributed on a nationwide basis. Alsynite's corrugated and flat polyester glass sheeting is also finding nationwide use for building panels, glazing, patio roofs (photo p. 156), skylighting, outdoor signs, and greenhouse panelling. In the same area of glazing applications, Everlite Corp., Seattle, Wash., has earned a nationwide reputation for its molded reinforced plastics skylights (photo p. 155). Chemold Co., Santa Monica, Calif., another specialist in reinforced plastics, is custom molding for Houston Fearless Corp., West Los Angeles, Calif., a polyester-glass photo development tank that can resist the chemicals and acids used in developing work without corroding or weakening in any way. Reflin Co., San Diego, Calif., has pioneered in the centrifugal casting of reinforced plastics pipe.

For Kenworth Motor Truck Co., Seattle, Wash., A. I. M. Plastics Co., Seattle, Wash., is fabricating a battery hold-down and tray of polyester-glass laminate (photos p. 156). The material was chosen for its corrosion resistance to battery acids and weather, its high strength, and its light weight. According to the company, important economic advantages were also achieved by switching from stainless steel to reinforced plastic materials.

One other new development which is attracting attention in the area of reinforced plastics is the technique created for using a surface coating of polyester resin and fibrous glass materials to transform ordinary concrete blocks into new architectural materials



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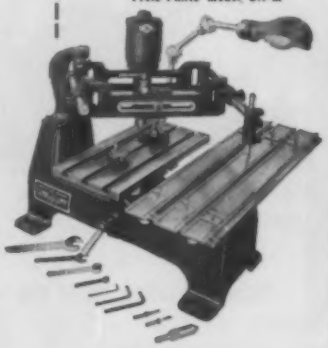

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(photo p. 155) that can be used for living room fireplaces, dining room walls, etc. Advantages of these new reinforced plastics blocks include their waterproofing qualities, their great compressive strength, and their decorative possibilities. The smooth plastic surface of the blocks is also scratch- and fade-proof.

Finally, mention should be made of the booming reinforced plastics boat business on the Coast. Like so many other plastic products connected with outdoor leisure-time activities, the concept of the reinforced plastics hull reportedly first caught on with the boating fraternity along the West Coast. And attesting to the enthusiasm with which they accepted the idea is the number of reinforced plastics boat builders that have sprung up in the past few years in the California and Washington coastal regions to service boating enthusiasts.

The largest of these many companies building reinforced plastics boats is probably Glasspar Co., Santa Ana, Calif., which turns out about 3000 hulls a year. Further to meet the needs of the fast-growing number of boating enthusiasts (at latest count, an estimate of the number of amateur sailors in Puget Sound alone was placed at 50,000), several companies, such as Fiberlay, Inc., Seattle, Wash., are setting themselves up to supply "do-it-yourselfers" with the resin and fibrous glass needed to build a new boat or resurface an old wooden one. In a unique operation, Fiberlay has also formed a subsidiary company, Fiberform Co., which sells, rents, or leases the molds for making a variety of boats—7-ft. dinghies to 20-ft. cabin cruisers.

Agriculture and industry

The Western agricultural region's basic contributions to furthering plastics applications have been in pioneering the use of polyethylene film as a mulch for fruits and vegetables and in perfecting the use of plastics pipe for irrigation purposes. The strawberry fields in California were one of the first experimental areas for polyethylene film and some agriculturists are already predicting

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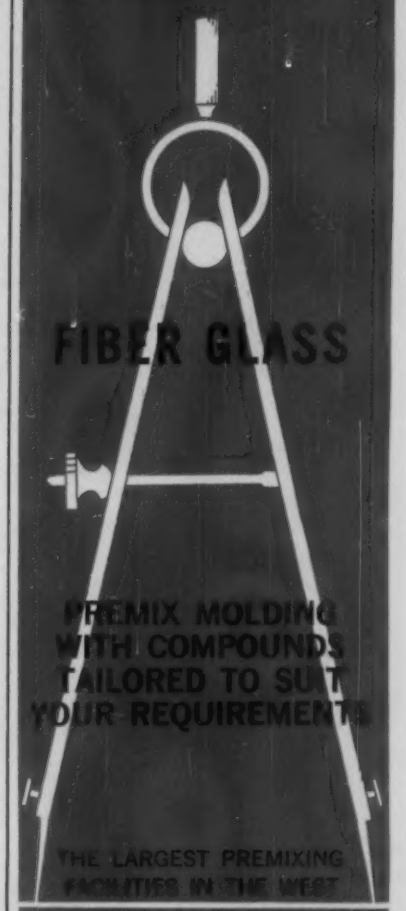
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that the benefits obtained may someday result in doubling the amount of marketable crops available from the West Coast.

Because of the vast amount of arid but arable land on the West Coast, the problem of irrigation has been, and probably always will be, a matter of prime concern. That area has long been interested in the advantages of plastics pipe for such applications, and much of the early field testing, particularly with polyethylene pipe, was done on the Coast. Butyrate pipe for gas transmission was first used in Southern California.

In contrast to the agricultural field, the West Coast's industrialization program has boomed so fast and in so many different directions that it would be impossible to point to any one type of industrial plastic product as typically regional in character. The only dominant influence thus far has been the electronics industry, which has given birth to such companies as Acroscope Engineering Co., in Los Angeles, which specializes in precision molding to close tolerances of slip rings, coil bobbins, and other electronic parts, using nylon or fluorocarbon materials. But aside from these, Western molders of industrial products cover a wide range—from tote boxes to pipe fittings. Thus, Sloane Mfg. Co., Pacoima, Calif., recently came up with a variation on a type of globe valve (photo p. 155) that can never rust and which will resist the corrosive action of many "problem" chemicals. Molded of acetate butyrate, the valve's interior surfaces are extremely smooth, permitting unimpeded flow. When closed, a positive plastic-to-plastic seal is formed. There are no washers to deteriorate and cause downtime. And since the valve is transparent, flow can be observed readily. The valve is available with either plain ends for "solvent-welding" to butyrate pipe, or with threaded ends, for connecting to threaded metal and plastic pipe.

Packaging, toys, housewares

The West Coast packaging industry can boast of important contributions to two of today's major packaging trends: the use of plastic film for packaging produce, and development work in adapting rigid, clear plastic containers to the new concept of "visibility merchandising." Containing as it does the heart of a large agricultural belt (oranges, celery, strawberries, other fruits and vegetables) and with many of its markets in the East, the West Coast has, of necessity, done a good deal of work with the use of polyethylene film as a protective wrap.

The concept of molded clear plastic containers, while not strictly a West Coast development, has been field-tested extensively in the Coast area. A good deal of this region's retailing set-up is based on the idea of the huge, sprawling shopping center, the focal point of which is generally a large "supermarket." In such retail outlets the molded "visibility" package has found its best customers.

In housewares and toys, a number of West Coast companies, including the Plas-Tex Corp. and Alladin Plastics, both in Los Angeles, have already made nationwide reputations for themselves in pioneering with king-size polyethylene houseware items. Similarly, other plastics housewares companies in the West have earned nationwide followings by offering unique design and styling features to offset the handicap imposed by the distance factor. One of these leaders, Blisscraft of Hollywood, located in Gardena, Calif., has recently expanded plant facilities to meet national demand. Modglin Co., Inc., Los Angeles, specialists in making plastic brooms, also recently announced development of equipment for extruding styrene bristles at the rate of 400 miles a day.

The toy field has also used design and styling innovations to advantage in competing with Eastern companies on a national footing. Eldon Mfg. Co., Los Angeles, for one, did much early pioneering work in unbreakable polyethylene toys, and more recently, has been experimenting with "king-sized" polyethylene toys on the order of large cargo plane, aircraft carrier, and auto transport models. Knickerbocker Plastic Co., Inc., North Holly-

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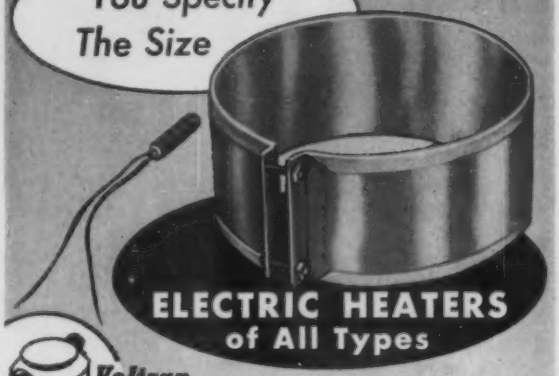

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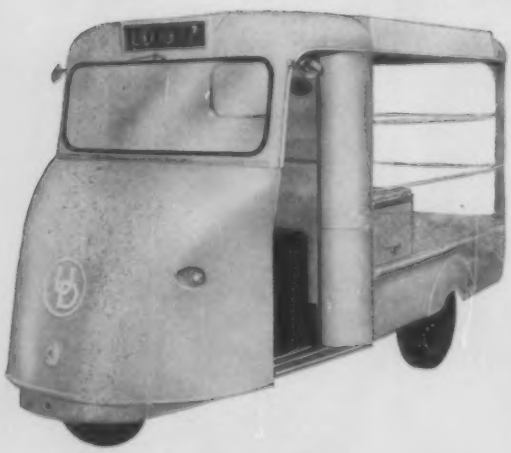

This all-plastic milk float, manufactured by Mickleover Transport Ltd. for United Dairies, employs **deeglas** chopped strand mat as its sole reinforcing material.

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wood, Calif., another toy manufacturer that has achieved nationwide distribution, recently announced that it had produced its 50 millionth toy dart gun.

Wide and diverse variety

Many of the products emanating from the West Coast reflect the personality of the Westerner and his individualistic way of life. Perhaps nothing reflects his interest in the bizarre more than the recently announced production out on the Coast of an authentic replica of a Jivaro shrunken head now being slush molded of vinyl plastisol on a conveyor oven by E. Joseph Cossman & Co., Hollywood, Calif. (Photo p. 156.)

And his love for outdoor life has resulted in the development of a number of sporting goods. Included among these is an inflatable vinyl waist belt fabricated of Bakelite's 12-gage vinyl sheeting by Plastimayd Products Corp., Portland, Ore. The belt, which can be quickly inflated or deflated, is used in water skiing (photo p. 157), fishing, camping, etc. In addition to keeping the wearer afloat, it helps to cushion falls when used by a water skier.

From the sports-conscious Northwest comes a mechanical duck decoy being molded of butyrate by Plastal Specialties Co., Seattle, Wash., for Riley Decoy Corp., Eugene, Ore. Operated from a small 4½-v. battery in the shooting blind, this duck (photos p. 157) goes through actual feeding motions, bobbing its head in and out of the water. In repose, too, it looks realistic. Its body, molded in lifelike proportions, is lacquered in the true colors of a wild duck. The gear box which holds the cams that control the bobbing motion is molded of high-impact styrene.

And from Warren Christmas Trees, Inc., San Bernardino, Calif., has come the first all-plastics Christmas tree (photo p. 158). Based on polyethylene and styrene, the tree is complete with stand, branches, and twigs—all ready to assemble into the finished product. All parts are numbered and replaceable and the entire tree can be dismantled in a few minutes. The branches and twigs

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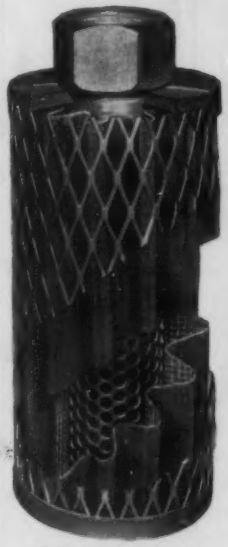

SUMP TYPE (cutaway)

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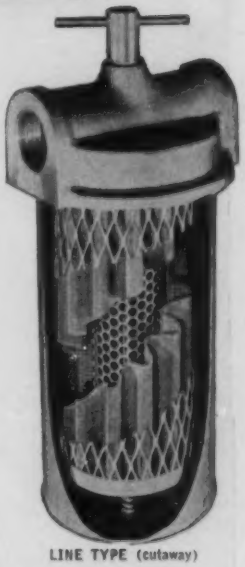

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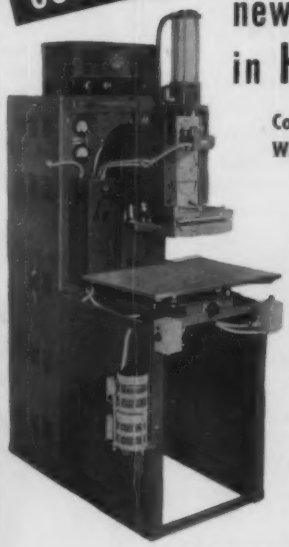

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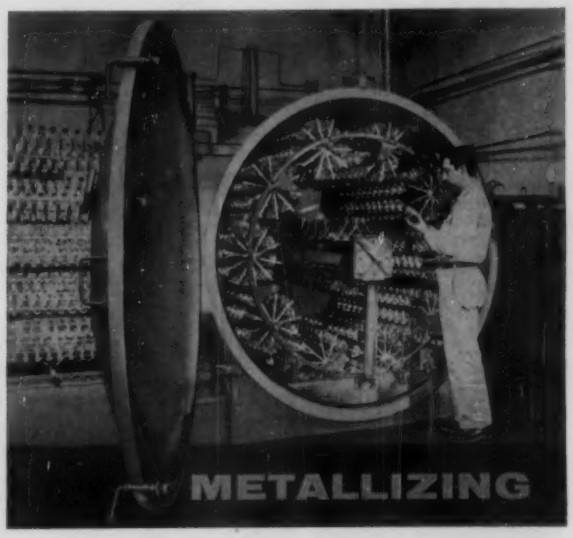
are injection molded of polyethylene to achieve a product with desired flexibility and a "life-like" appearance and feel. Some 18 months of research and work went into making the molds for the job in order to assure a refreshing variation in the branches —a bend here, a twist there, or an occasional up-turn or down bend. The base of the tree and the trunk are molded of styrene, chosen for rigidity and its ability to support weight. Both styrene and polyethylene are supplied by Monsanto.

The plastic Christmas tree has many advantages — paramount among which are the facts that there is no shedding and the plastic will not flare up from a spark or the heat of a Christmas tree light. The various sizes in which the tree is available allow a customer to choose a small tree and to add to it in succeeding years; nothing wears out or rots.

From Denver Plastics, Inc., Denver, Colo., comes announcement of a line of beer barrel plugs and tap plugs (photo p. 157) molded of polyethylene. The plugs are designed to replace cork formerly used in metal beer kegs to hold the beer in until the keg is tapped by a tube leading to the draft spigot. In contrast to the corks which sometimes pop out, chip, crumble, allow seepage, or otherwise cause keg losses, the polyethylene tap plugs are uniform, sterile, and tasteless, can't chip or crumble, and hold fast under all conditions from freezing cold to desert heat. They will not blow out, even under pressure that would ordinarily bulge the keg bottom. The U. S. market for this one item is estimated to be about 120 million plugs a year.

In another revolutionary West Coast development, millions of miles of wasted newsprint are now being saved each year through the use of polyurethane foam as a filling in bumper pads. (Photo p. 158.) Until the pads were developed, unloading newsprint presented a considerable problem. Because of the tremendous weight of newsprint rolls—up to 1800 lb. —the cumbersome cylinders have to be toppled and rolled when being unloaded from ships at

(*To page* 286)



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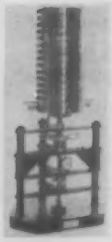

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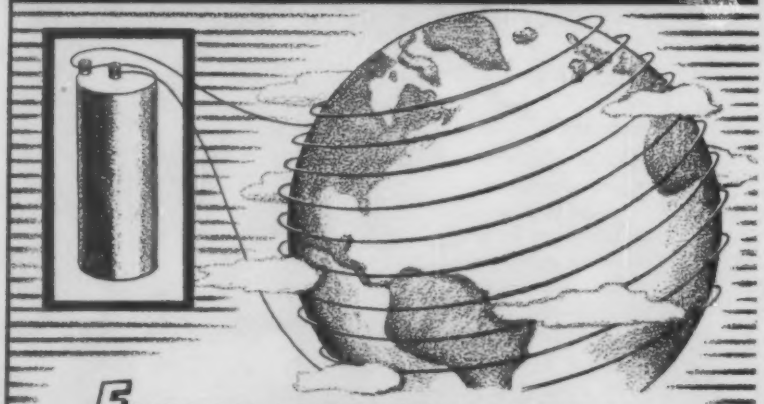

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1 1/8"	V	V		V	V	V	
1 3/16"	V			V			
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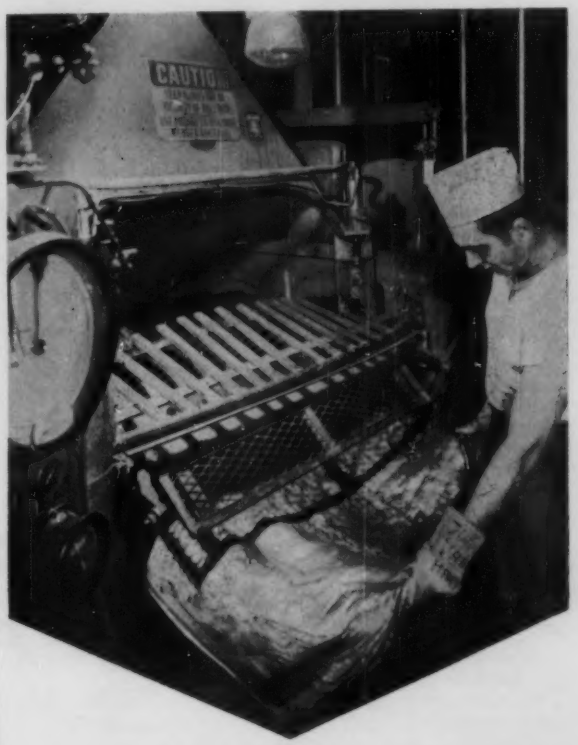

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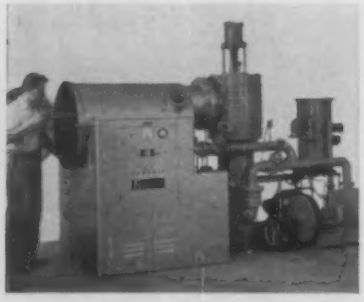
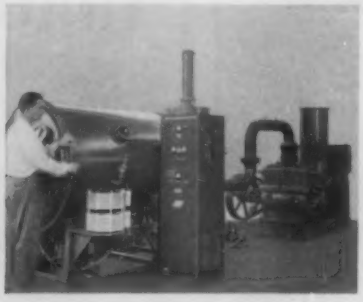


30″ coater—model LCI-30
Typical production: 400 1½″ diameter pieces per cycle; 5 to 7 cycles per hour.



48″ coater—model LCI-48C
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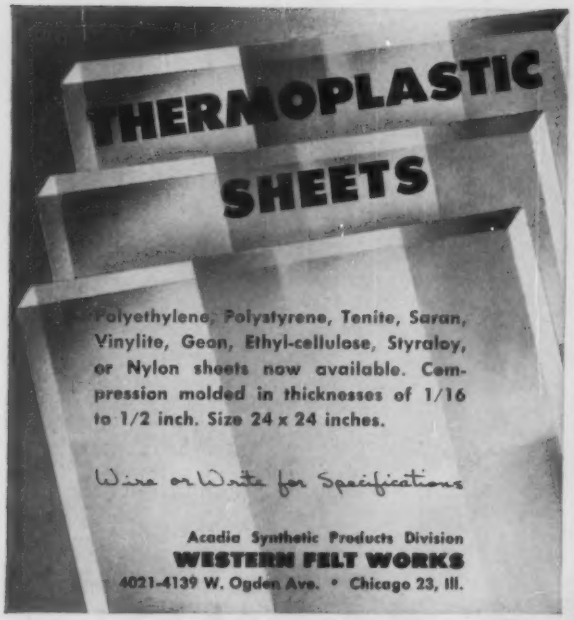
dockside. Thus, hundreds of feet of newsprint from each roll had to be discarded because it was torn and wrinkled on the edge and could not be run through presses.

By placing bumper pads under the rolls to cushion the shock when the stevedores pull the rolls onto the dock, most of this waste can be eliminated. The problem, however, of selecting the type of filling for the pads remained. Almost every type, including foam rubber and rubberized hair, was tried. Not only did they lack the resilience to withstand the crushing impact of the toppled newsprint rolls, but many of the fillers were so heavy that the pads required two men to put them in place.

With polyurethane as a filling, the problem was solved. The polyurethane foam not only weighed about half as much as foam rubber, but it offered a "slow-memory" factor. It may take as long as 180 sec. for the foam to return to its original shape following a sharp, heavy impact. Complete with a vinyl-coated nylon covering, the pads weigh only about 35 lb.—light enough for one man to handle.

Another outstanding West Coast product is a portable record holder, known as Disk Jockey, molded of high-impact styrene. The circular unit (photo p. 157) is molded by Wilcox Plastics, Inc., Montebello, Calif., for Conrad Corp., Los Angeles, Calif., and is designed to hold securely and protect ninety 7-in. records. Molded-in slots hold the records in place, preventing scratching, marring, or chipping. When filled, the unit weighs only 10 lb.; it measures 15 in. in diameter, for ease in handling and storing.

The products and processes discussed in this roundup represent only a small sampling of Pacific Coast plastics activities. They are, however, significant in that they reflect the four main influences involved: a) the type of end-user industry native to the area, b) the kinds of plastics processing required to serve those industries, c) the pioneering spirit which Westerners bring to all effort, and d) the living habits of the people concerned.—END



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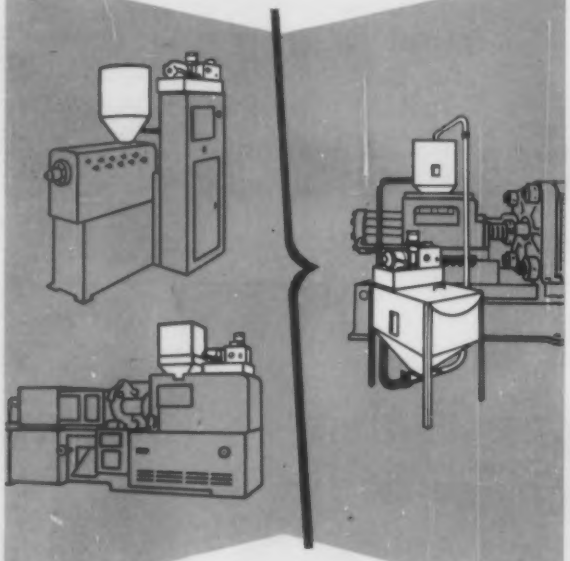

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Pressure preforming

(*From pp.* 161-164)

impact strength, even at the 60% glass level, is considerably higher. Surprisingly, flex modulus of the high-glass samples is higher for the preformed pieces than for the conventional laminate. The differences among the values given for the 80/20 and 90/10 preforms of the two fiber lengths show no consistent patterns. When they are judged by the standard deviations that can be calculated from the data of Table II, none of the differences are significant, but reflect the variability accumulated in the preforming, molding, and testing stages. At the 60/40 level there are some significant drops in properties, as would be expected; the size of cut again seems to make little difference, except in impact strength.

To sum up, it appears that the pressure preformed test samples containing 80% or more glass are at least as good in physicals as all-glass laminates made by conventional methods, and are superior in impact strength. With a glass content of 60% in the preform (only 38% by volume) the flex and tensile properties are a little lower, but impact is still good and still surpasses that of the conventionally made all-glass laminate. Thus a *finished molding* containing only 17% by volume of glass has a very respectable set of properties.

At present, Pressurform is developing a second container for components of the Falcon missile. There is no doubt, however, that containers are only the beginning[3] A tremendous range of large-volume applications, in which reinforced plastics could not previously compete with other materials, are made economically practicable by the pressure preforming process. Likely prospects are auto bodies, luggage, boats, bathroom fixtures, furniture components, machine housings. Since a considerable initial investment in the preforming equipment is required, the economy of the process is only realized when the production volume is large.—END

[3]However, don't belittle the container market: 7% of our national defense budget is spent on various forms of packaging, and non-military packaging is an even bigger item.

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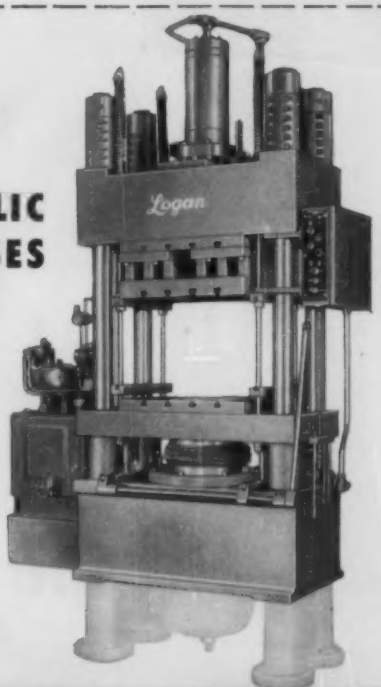

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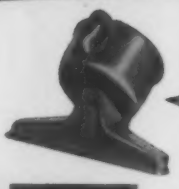

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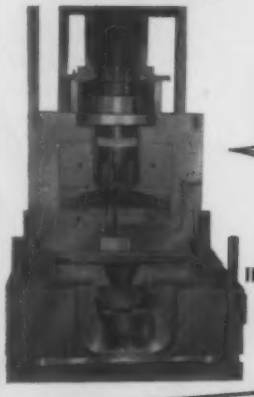

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Better calenders

(*From pp.* 165-172)

directly to the rolls through universal spindles. The motors are mounted on a special, welded-steel stand, and with this arrangement the motor diameters cannot greatly exceed the diameters of the rolls.

The second design is a semi-uni-drive arrangement. This arrangement provides the following two advantages:

a) The final heavily loaded gear reduction, instead of being a planetary gear set included in the gear motor, consists of wide-faced, cut, double helical gears rigidly mounted in a heavy, welded-steel case; b) the gear motors can be offset, providing easier and more accessible mounting and the possibility of using motors that have larger diameters.

This individual roll drive is not limited to production-size calenders, and, in fact, it would appear to be even more desirable if it were used for the laboratory-size unit.

Conclusion

Many other items could be mentioned which are of importance in designing a calender for the production of modern materials. However, these features, such as drilled rolls, circulating-liquid, roll-temperature-control systems, and two-speed motorized roll adjustments have, in the course of time, become standard equipment.

The purpose of this paper has been to emphasize important design features that should be considered in order to minimize obsolescence of calendering machinery.

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2. M. Jukich, "Roll bending," Modern Plastics *33*, 138 (Apr. 1956).

3. Timoshenko, S., "Strength of Materials," Part I, Second Edition, p. 158. 1940. New York: D. Van Nostrand Co.

Molders confirm press-makers' tests;

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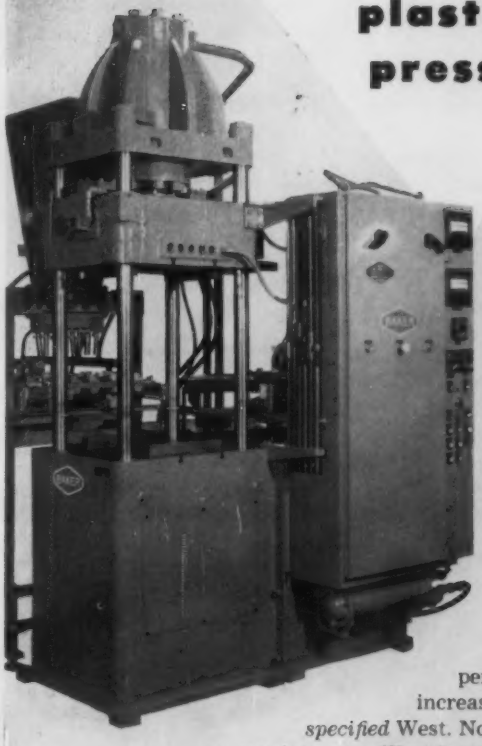

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Volume and pressure

(*From pp.* 173-182)

that gave about the same part thickness as that of 175 g. of Diall 50-01. The curves are shown in Fig. 9, p. 182, and will be discussed here only briefly:

Diall 51-01 and 52-01: The behavior of these compounds is similar to that of Diall 50-01; all show a high apparent chemical shrinkage. The resin on which these compounds are based is known to have a high chemical shrinkage.

Diall 50-51: This material is reputed to have faster curing characteristics and slightly higher shrinkage than Diall 50-01; this is indicated by the curves.

Durez 14482 and 16274, and Bakelite BM-120: These two-step phenolic materials have curves with the same general shape as the Diall compounds but with lower apparent chemical shrinkages. This corresponds to the low chemical shrinkage of the resins used in these compounds.

Durez 1900, 1905, and 16221: These one-step phenolic molding compounds have curves with a distinctive shape that lack the rapid final drop of the other curves. This may be due to the generation of large quantities of volatiles during molding. Note also the almost complete lack of apparent chemical shrinkage in Durez 16221. In Ref. 2, one-step phenolics showed a similar phenomenon as demonstrated by a high pressure-buildup and lack of pressure loss on parts during molding in a transfer mold.

Alkyd 446: This material has the high apparent chemical shrinkage expected of polyester resin compounds, and the curve shows the very rapid cure also characteristic of these materials.

Conclusions—unlanded mold

Punch-travel curves reflect the character of the molding materials used and are sensitive to processing conditions. They are a useful and quantitative guide to what is going on in the mold during the molding cycle. While the curves shown are representative of these materials, they probably also depend somewhat on the mold dimensions and might differ a little in shape if a different mold were used. For example, part thickness and clearance between punch and cavity will influence the curve shape. It seems likely that punch-travel studies with a standard mold, such as the A.S.T.M. punch mold, would yield much more information and much more complete characterization of resins than the present test procedure.

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1. "Role of pressure, temperature, and time in the injection molding process," by G. D. Gilmore and R. S. Spencer, MODERN PLASTICS *27*, 143 (April 1950).

2. "Internal pressure distribution in molding phenolic test bars," by J. M. Rausch and W. Orvis, SPE Journal *12*, 24 (Jan. 1956).

3. "Measurement of residual stress in thermosetting plastics," by Russell De Waard, Charles R. Stock, and Turner Alfrey, Jr., A.S.T.M. Bulletin, April 1952.

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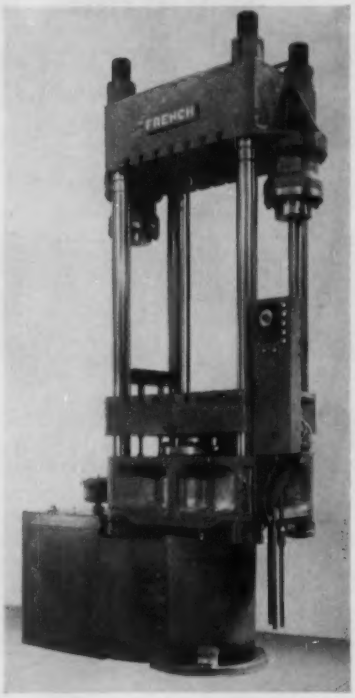

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Adhesives for vinyl

(*From pp.* 208-210)

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Ultra-violet resistance: In applications such as wall covers, upholstery, wearing apparel, and in general where a clear vinyl or lightly colored vinyl is laminated to cloth or other surfaces, the adhesives used must have good ultra-violet resistance. Checking the Fadeometer discoloration of the laminated material will tell whether or not the adhesive will perform satisfactorily.

Low-temperature flexibility: This property is most important in vinyl-cloth laminations where undue stiffening of the adhesive will alter the draping or conformability of the lamination and render it unsatisfactory for use. This is particularly true in the vinyl-to-cloth laminations for outer wear. The evaluation of satisfactory low-temperature flexibility of an adhesive for vinyl-to-cloth lamination is usually made at the prescribed low temperature using the same methods for evaluation as used in determining initial softness.

Water resistance: This property is most applicable in vinyl-to-cloth laminations for outer wear. Water resistance of a vinyl-cloth lamination is determined usually by immersion in water at room temperature or at approximately 110° F. (to simulate body moisture temperature). Immersion tests for 24 hr., with determination of loss of bond strength, are usually made.—End

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The Plastiscope

News and interpretations of the news
By R. L. Van Boskirk

Section 2 *(Section 1 starts on page 47)*

Cyanamid's polymethylstyrene ready for market

What could become a highly significant event in the history of polystyrene progress appears about to take place: American Cyanamid Co. is apparently ready to ship commercial quantities of its new polymethylstyrenes after a year and a half of careful preparation for entrance into the field with its new Cymac 400 and Cymac 201.

There are several highlights in the new venture which mark the entrance of Cyanamid into the thermoplastics field. The new polymethylstyrene can be boiled for 30 min. and sometimes longer without distortion, yet it is said to retain all the desirable properties of conventional polystyrene. The monomer (methylstyrene) can be used as a copolymer with acrylonitrile, of which Cyanamid is the pioneer and largest producer. The monomer is also claimed to be equally as satisfactory for GR-S rubber, latices, polyester resins, and other uses where conventional styrene is now used. Chemical structure of the molecules in the monomer is such that the resulting properties are claimed to be considerably different and, according to Cyanamid, superior to the older alpha methylstyrene and vinyl toluene monomers which have been on the market for several years.

Toluol base. Not the least of the differences between Cyanamid's methylstyrene and conventional styrene is that one of the base stocks is toluol rather than benzol; the other base stock is acetylene. Toluol is now 32¢ a gal. in tankcar lots, compared with benzol at 36¢ and is less likely to be affected by periods of scarcity than is benzol.

Cyanamid chemists say that the difference between their material and other methylstyrene varieties is that their product contains 65% para isomers, 33% ortho, and 2% meta. The ortho isomers are what creates heat resistance. Other methylstyrenes are likely to be high in the meta isomer and are not generally used alone for molding material.

Conventional polystyrene has proved itself a satisfactory molding material for scores of uses. Consumption has grown from less than 100 million lb. in 1946 to almost 400 million lb. a year at present. But a polystyrene with improved properties could easily broaden this base. Brittleness, lack of heat resistance, and crazing rule out general-purpose polystyrene in many applications. Impact resistance has been obtained by modification with a rubbery constituent, and improvement in heat resistance has been obtained either by reducing the residual content of unreacted monomer in the polymer or by copolymerization, but it hasn't been improved enough to produce a material that would withstand long periods of boiling. And both improvements have resulted in higher cost.

Molding advantages. Cyanamid literature states that Cymac 400 may be repeatedly heated to 100° C. with shrinkage less than 0.31 percent. Ordinarily, it can be molded in conventional injection machines at a temperature only 50 to 75° F. higher than that used for general-purpose polystyrene or a cylinder temperature of from 400 to 550° F. Molding cycles and pressures are the same as for other polystyrenes—in some cases the molding cycle is shorter.

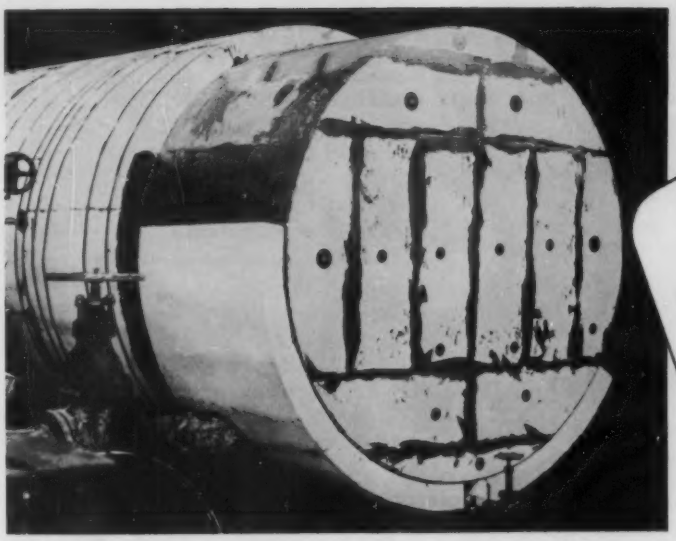
Because of its heat resistance, Cymac 400 will reduce the possibility of distortion of molded parts at the abnormally high temperatures which may develop in locations such as store windows exposed to the sun, the interiors of automobiles, or areas exposed to the radiant heat from lighting fixtures. Housewares will not be expected to distort should they be exposed to the hot water used in dish washers. Picnicware and such items as potato salad or delicatessen containers could be molded in Cymac 400 and thoroughly scalded after use.

Chemical resistance of Cymac 400 is the same as other polystyrenes. Electrical properties, clarity, and almost zero water absorption are also on a par with conventional polystyrene.

Acrylonitrile copolymer. It is expected that Cyanamid will put particular selling effort into its marketing plans for Cymac 201, the methylstyrene-acrylonitrile copolymer compound. Cymac 201 contains about 30% acrylonitrile. Years of research in acrylonitrile development are behind Cyanamid's effort to produce a superior copolymer of this type. There are now several similar varieties on the market. C-11 and Styrex are said to be straight styrene-acrylonitrile copolymers. Cycolac is thought to be a combination of both with butadiene. Kralastic formulations include a great many varieties that use styrene, acrylonitrile, butadiene, and nitrile rubber in varying proportions. But it is reported that the methylstyrene used by Cyanamid in Cymac 201 gives this material characteristics which are different from all the others.

Outstanding features. Cymac 201's outstanding features are its high heat resistance, which is approximately the same as Cymac 400; capability of being molded in any equipment designed for use with regular polystyrene; resistance to crazing; good resistance to solvents and chemicals, including gasoline, many essential oils,

*Reg. U.S. Pat. Off.



MOLDED STYRENE FOAM TO STEEL

Two 4" thick layers of molded "Dylite" were needed in order to maintain a constant temperature of 40° below zero within this 6' x 20' welded steel tank. Thin coatings of BONDMASTER G398 enabled Medical Arts Laboratories, Inc., Miami, Florida to do this pressure-free bonding job with "greater speed, less labor, lower costs".

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and fruit acids; and higher tensile and flexural strengths (toughness) than either unmodified polystyrenes or Cymac 400. It has the same clarity as other copolymers of similar chemical content. It has slightly higher water absorption than Cymac 400 but is comparable with other styrene-acrylonitrile copolymers. Like other such copolymers, Cymac 201 is incompatible with both polymethylstyrene and polystyrene so that machines must be purged before molding. Shrinkage is approximately the same as for general-purpose polystyrenes, and mold designs need be no different than those for other styrene-type materials.

Some of the suggested applications for both of the new polymethylstyrenes are radio cabinets, industrial battery cases, housewares, phonograph records, brush backs, hospital and medical apparatus, film and sheet, and stove and washing machine parts. In addition, Cymac 201 is suggested for electric fan blades, combs, auto interior parts, business machine housings, clock faces, tumblers, and electric or gas range faces.

Cymac 400 in clear will sell at 27½¢ in 20,000-lb. lots, the same price as general-purpose polystyrene. Cymac 201 in natural and ice will sell at 40½¢, the current price for styrene-acrylonitrile copolymers in 80,000-lb. lots or more. Colors are available in both materials.

For more details on chemical structure and performance of Cymac, see MODERN PLASTICS *33*, p. 163, March 1956.

Polyethylene protest

A statement in the December 1956 Plastiscope concerning oxidation of polyethylene brought an answer and correction from R. Vernon Jones, technical service and development manager of Phillips Chemical Co. Says Mr. Jones:

"The statement which suggested that low-pressure polyethylenes are more vulnerable to oxidative degradation than the older, high-pressure types brought a shock to us. We have found that the resistance to thermal degradation of at least one low-pressure polyethylene (Phillips' rigid Marlex 50 polyethylene) is the same as that of the conventional polyethylenes. These results were based on oxygen uptake tests which show essentially identical slopes and induction periods. On the other hand, it has been our experience that the Marlex 50 type polymer is equivalent or, in some cases, shows greater resistance to photochemical degradation than does conventional polyethylene based on Atlas fadeometer exposure tests and reports furnished us by customers . . . it is one of the reasons we prefer to think of Marlex 50 polyethylene as distinct from other polyethylenes."

Super-size cast acrylic in color

Availability of cast acrylic sheets in sizes up to 8½ by 10 ft. has been announced by Rohm & Haas Co., Philadelphia, Pa. Called Plexiglas RL, the sheets are furnished in both colorless transparent and in translucent colors. The company states that this is the first time colored sheets have been available in sizes larger than 5½ by 8½ feet.

Colorless transparent sheets have been available in extra large sizes in the standard Plexiglas II UVA grade, but the new colorless RL sheets are priced from 17 to 27% less than comparable sizes in Plexiglas II UVA.

Rohm & Haas asserts that Plexiglas RL was introduced to meet a growing need for larger sheets for internally illuminated signs of all kinds, large-area glazing, fluorescent light diffusers, dome skylights, and other architectural applications. It is manufactured to the same surface standards and optical quality as Plexiglas R, the firm's commercial quality, untrimmed, unmasked acrylic sheet which was introduced in 1955. The RL sheets have the same physical and chemical properties and the same outdoor weathering characteristics as both Plexiglas R and Plexiglas II UVA.

Plexiglas RL is supplied as untrimmed, unmasked sheets in thicknesses of 0.187 and 0.250 in. and in sizes of 72 by 100, 84 by 84, 96 by 96, and 102 by 120 inches.

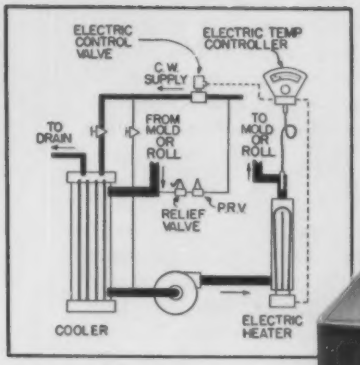
Catalyst for polyolefins

One of the secrets for success in production of polyolefins by the stereospecific system is the catalyst. According to the literature, the so-called Ziegler method uses tri-alkyl aluminum and titanium tetrachloride. The Natta method emphasizes use of aluminum alkyl with titanium trichloride. The Phillips' method is said to employ a chrome catalyst.

The Natta method has been mentioned primarily as a system for production of polypropylene. This system includes development of the professor's famous isotactic polymer which is noted for its steric or spiral structure and high crystallinity which help to give superior heat resistance, strength, clarity, and other desirable properties to the polymer. There is a theory in the industry that the smaller amount of chlorine in the titanium trichloride gives it certain advantages over tetrachloride in the catalytic process.

Use of titanium trichloride is claimed to make possible the production of a larger percentage of the isotactic polymer; according to one of Natta's speeches, the percentage of isotactic polymer obtained from propylene monomer would be 85 to 95% with the trichloride and 34 to 45% with the titanium tetrachloride.

Until recently, titanium trichloride has been available in only ounce or gram quantities. Polymerizers of polyolefins who have experimented with it generally made their own. Now, however, titanium chloride has been made available in quantities ranging up to hundreds of pounds by Stauffer Chemical Co., 380 Madison Ave., New York, N. Y. The material is provided as a dark purple powder with a density of 7 to 30 lb./cu. foot. It is



Schematic sketch of the control circuit in the Sarcotrol Model MC-1, Single Unit. Model MC-2, Dual Unit, is equipped with two of these circuits, MC-3 has 3 circuits.

Before you buy...Compare

all Temperature Control Units for molds, rolls, cylinders, drums

COMPLETELY redesigned, the new *Sarcotrol* heating and cooling unit is fully automatic as shown in the following list of features. It maintains even face temperatures by recirculating temperature-controlled water at high velocity through molds or roll jackets. Check *Sarcotrol's* features against any other unit *before* you buy.

Sarcotrol gives you *all* these features

- **Dependability** — built and guaranteed by Sarco, makers of temperature controls and steam traps since 1914.
- **No need for special heat transfer liquids** — temperature-controlled water to 300° F. is recirculated at high velocity in closed system.
- **Independent circulating systems** — the Sarcotrol is available with one, two or three independent systems (see above sketch).
- **Simple, sensitive control** — one knob changes temperature control setting; sensitive thermostat (±1°) minimizes temperature lags; easy-to-read dial shows both desired and actual temperatures.
- **Automatic selection of heating rate** — for fast heat-up; then close control.
- **Saves electricity and water** — the *same* thermostat regulates both *rate* of heat input and cooling; cuts out both when set temperature is reached.
- **Automatic heater protection** — heaters are automatically cut off when pump is shut down.
- **Many other features** — are listed in the *Sarcotrol* technical bulletin.

2189-B

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soluble in water, ethyl alcohol, and acid solutions; it is insoluble in ethyl ether and organic solvents. Aqueous solutions hydrolize readily to form strongly acid solutions.

It is expected that all producers of polyolefins, including polyethylene, will be interested in the availability of this catalyst which has proved so interesting in the low-pressure and stereospecific systems.

Plastics symposium

Plastics and High Polymers Div. of International Union of Pure and Applied Chemistry will hold a symposium on July 25 and 26, 1957 in Paris, France. Subject of the meeting is "Relationships between physical chemistry and standardization of elastomers, fibers, and plastics in relation to their structure."

Registrations for the symposium should be sent, independently of registrations to the 16th International Congress of Pure and Applied Chemistry, to the secretary of the division, Prof. Pierre DuBois, 292 rue Saint-Martin, Paris 3è. Fee is 2.000 Fr. (ca. $6.00.)

Styrene and paper sandwich

Development of production and market possibilities for a unique foamed styrene-and-paper sandwich material recently developed has been undertaken by Monsanto Chemical Co. and St. Regis Paper Co. In its basic form, the product, known as Fome-core Board, consists of a core of stiff foamed styrene with a sheet of specification kraft paper on either side. This sandwich of paper and plastic foam is produced in a continuous operation. It retains high compression strength under conditions of severe humidity and provides excellent insulation qualities.

The two companies will combine their technical and marketing knowledge to develop packaging uses for the new material. The move is part of Monsanto's long-range program to develop materials and markets in the field of foamed plastics and St. Regis' program to develop materials and markets in the paper and container fields.

New container. St. Regis announced recently that it would begin limited commercial production of its new container made of this board. Equipment is now being installed at the Mt. Wolf, Pa., plant of St. Regis' subsidiary, Superior Paper Products Co. The board will be converted into containers at the Mt. Wolf plant and at other converting plants of St. Regis.

The new container is light in weight, which keeps shipping charges low, and strong enough to withstand long distance shipping under the high humidity conditions of refrigerator cars and trucks. It should compete favorably in strength and economy in those fields in which expensive wooden and solid fibreboard containers are now being used.

New Celanese plant in Mexico

Construction has been started on a new chemical plant for the manufacture of formaldehyde and the formulation of synthetic resins derived from that intermediate raw material by Celanese Mexicana, S.A., an affiliate of Celanese Corp. of America. The new facility, located 12 miles north of Mexico City at San Cristobal Ecatepec on the Mexico Laredo Highway, will help supply Mexico's needs for components used in the manufacture of plastics and the finishing of various textile products. The planned production of formaldehyde marks the entry of Celanese Mexicana into the chemical producing field, further expanding its textile and plastics operations.

Additional facilities will be constructed at San Cristobal Ecatepec to house certain Celanese Mexicana manufacturing and storage operations now located in Mexico City. These include units for the production of polyvinyl acetate emulsions and polyester resins, as well as a chemical storage tank farm. The company's other plastics manufacturing facilities will remain in Mexico City.

Celanese Mexicana, started as a one-plant venture in 1946 to produce cellulose acetate filament yarn, today has five major manufacturing plants. The company now produces acetate filament yarn and staple fiber; viscose filament yarn and staple fiber; rayon tire cord and fabric; cellophane; acetate plastic sheet and film; polyethylene sheet, film, and tubing; polyvinyl acetate emulsions; purified cellulose made from Mexican cotton linters; and fabricated polyester resin products. A new facility for the manufacture of nylon yarn was recently brought into operation at Ocotlan, state of Jalisco.

Services for the coatings field

Three major services to industry are being offered by The G. S. Plastics Co., 15583 Brookpark Rd., Cleveland, Ohio, which was recently formed. The services are: 1) a custom service of applied coatings, using vinyl plastisols, epoxies, neoprene, and other materials; 2) manufacture of these coatings for resale in any quantity; and 3) manufacture of coated equipment (lined tanks, plating racks, materials-handling devices, etc.).

William A. Munkacsy is president; associated with him is Thomas R. Gill, president of The General Supply Co. and vice president of The Singleton Co., two affiliated companies.

Erie to metallize

A vacuum metallizing service for custom molded parts is being offered by Erie Plastics Div. of Erie Resistor Corp., Erie, Pa. In the Erie technique, called the Top Surface Metallizing Process, an evaporated metal film is deposited on a specially developed, firmly adherent, tough undercoat and is then protected by a clear mar-resistant topcoat. The metallized finishes are required to pass score-and-tape tests, as well as humidity, fading, and thermal

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CHEMICAL PROGRESS WEEK—APRIL 8-12

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shock tests. The company states that the finish will not tarnish, pit, or rust, and that it will maintain its brilliance under adverse conditions.

To provide additional manufacturing facilities for the expanding Plastics Div., Erie has constructed a new plant in Andover, Ohio. This new factory will house production equipment for vacuum metallizing and other finishing operations, in addition to molding presses.

Patents for bottles

The U. S. Circuit Court of Appeals for the Third District has upheld a lower court decision affirming that Lamex Chemical Corp., Manchester, N. H., did not infringe on patents held by Plax Corp. for the manufacture of polyethylene bottles. In an opinion filed January 9, 1957, the Court stated that of the two patents held by Plax on the process, only one is valid and in no case did Lamex infringe on this patent.

The Court of Appeals found that the two patents held by Plax were decidedly similar and that the steps involved in the second patent constituted "a difference in mechanics rather than a difference in process." It stated that there was not a patentable difference between the two and reversed the lower court decision on that point, declaring the second patent invalid. The Court also affirmed the judgment that Lamex had not infringed on the original Plax patent.

Aromatics for plastics

More benzene, toluene, and xylene, which are used in the manufacture of such items as phenolics, nylon, polystyrene, synthetic detergents, insecticides, paints, and aniline dyes, will soon be available from U. S. Steel Co.'s multimillion dollar hydrogen plant now under construction at Clairton, Pa. U. S. Steel will operate under rights acquired by Koppers Co., Inc. from a German firm that first developed this advanced hydrogen process. Koppers has authorized The Girdler Co., Louisville, Ky., to start the engineering work.

The hydrogen at Clairton, site of the world's largest coke plant operation, will be made by a steam-hydrocarbon reforming process and coke oven gas is to be used as the fuel. Girdler catalysts will be employed throughout the hydrogen facility.

In the past, crude light oil had been refined by washing it with sulfuric acid and caustic. At Clairton, a pressure catalytic refining process will be introduced which will eliminate virtually all of the impurities contained in the three chemicals recovered in the coking operation.

The new U. S. Steel aromatics plant is expected to be ready late in 1957.

British Plastics Exhibition

More than double its previous amount of floor space will be occupied by the British Plastics Exhibition and Convention in the Grand and National Halls, Olympia, London, England, from July 10 to 20, 1957. The convention will list speakers from all over the world and the exhibition, which is held every two years, will contain displays from plastics manufacturers representing eight or more different countries.

A limited amount of booth space is still available, applications for which should be made to John L. Wood, British Plastics Exhibition, Dorset House, Stamford St., London S.E.1. The exhibition is organized with the full cooperation of the British Plastics Federation by *British Plastics*.

Vinyl group elects

At the annual meeting of Vinyl Fabrics Institute, 65 E. 55th St., New York, N. Y., the following officers were elected: president—Fred L. Ford, vice president, Athol Mfg. Co., succeeding S. Ernest Kulp, vice president, Masland Duraleather Co.; first vice president—C. Gordon Jelliffe, Columbus Coated Fabrics Corp.; second vice president—Paul Howard, Weymouth Art Leather Co.

In addition to the officers, six members of the executive committee were elected as follows: M. N. Nickowitz, Du Pont; J. W. F. Young, Federal Industries; J. P. Haughton, Joanna Western Mills Co.; J. D. Lippmann, Textileather Div., The General Tire & Rubber Co.; W. J. Mulvey, U. S. Rubber Co.; and S. Ernest Kulp, Masland Duraleather Co.

Vinyl Fabrics Institute is composed of 20 companies manufacturing vinyl-coated fabrics and unsupported vinyl sheeting for such markets as automobiles, furniture upholstery, wall coverings, footwear, and luggage.

Electrical-grade phenolic

An ammonia-free, wood flour-filled phenolic compound, Durez 18441, has been developed by Durez Plastics Div., Hooker Electrochemical Co., North Tonawanda, N. Y., especially for use where a single-stage electrical-grade material of general-purpose type is required to minimize corrosion of electrical contacts and metal inserts. The compound is said to have a very fast rate of cure, good finish characteristics, and low gravity.

The company claims that Durez 18441 is especially suitable for automatic compression, plunger, and transfer molding processes.

Detector crayons

Sensitive detector crayons for the detection of phosgene, hydrogen cyanide, cyanogen chloride, cyanogen bromide, and lewisite are now commercially available from Aromil Chemical Co., 5646 Belle Ave., Baltimore, Md. These crayons will write on paper, wood, or any other suitable surface, and the resulting mark will reportedly turn to a distinctive color when exposed to very low concentrations of the appropriate gas.

Since each crayon is said to be good for hundreds of tests, Aromil claims that it provides an extremely simple, convenient, and inexpensive means to test for the presence of these toxic gases and

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All passenger windows in Lockheed's new Electra will be Swedlow's new Stretched Acrylic plastic material. It provides excellent visibility... and its extra toughness assures an extra factor of safety.

Naturally, we feel that Lockheed made a good choice. Other factors influencing Lockheed's decision were:

Highest quality of workmanship and service · Reliable delivery records · Technical expertness in formulating and fabricating plastics.

For complete information on the new Swedlow "Stretched Acrylics" and other Swedlow plastic products, we invite your inquiry on your company letterhead.

Ultra-modern Sky Lounge on the Lockheed Electra. High visibility provided by Swedlow "Stretched Acrylic" windows.

New Lockheed Electra—For short and medium range commercial transport, payload 21,638 lbs. Cruising speed 405 m. p. h. Range 2700 miles, without touching reserve fuel. Can load at full load on 62% of nation's airports. 2400 ft. per min. climb. Operates to 30,000 ft. altitude. Wingspan 99 ft. Fuselage 104 ft. 6½ in. Tail height 32 ft. 1 in. Passenger capacity 66 to 91 Four 3750 H. P. Model 501 D-13 propjet engines. Full production in 1958.

SWEDLOW "STRETCHED ACRYLICS" HAVE AMAZING PROPERTIES

Stretching of acrylics on a production basis has been a Swedlow-sponsored development over the last few years. The process involves the molecular rearrangement of acrylic sheeting by appreciable mechanical stretching.

Results — *Excellent Visibility* | *Higher Resistance to Stress Crazing* | *Greatly Improved Toughness* | *Reduced Notch Sensitivity*

Do YOU have an application requiring these features? If, so we'd like to serve you. Write TODAY!

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Please Refer to Dept. 15

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for detecting and locating leaks in cylinders and gas-contained systems.

The hydrogen cyanide detector is said to detect 10 p.p.m. of hydrogen cyanide in less than five minutes. This concentration has been adopted as the maximum average allowable concentration for exposure to hydrogen cyanide over an eight hour work day. A higher concentration of gas is claimed to give a more rapid test, in proportion to the gas concentration.

Symposium on injection molding

Another engineering institute in plastics (the fifth) has been announced by the Department of Engineering of the Extension Division of the University of Wisconsin, Madison. It will deal with injection molding and is scheduled for March 7 and 8, 1957. Fee for the sessions is $20.

The fourth institute, held last October on the subject "Plastics: Application in Product Design," drew an attendance of 104.

S.P.E.'s first book

Publication of its first book, "Quality Control for Plastics Engineers," has been announced by the Society of Plastics Engineers, Inc., 34 E. Putnam Ave., Greenwich, Conn. The volume, produced by the S.P.E. Committee for Quality Control under the chairmanship of Dr. Lawrence M. Debing of Monsanto Chemical Co. and published by Reinhold Publishing Corp., is the first in a contemplated series of technical books to be published by S.P.E. A full review will appear in a later issue.

Pipe from Texas

United Pipe & Tube Co. has recently opened its plant in Lubbock, Texas, and will extrude rigid PVC and styrene-butadiene-acrylonitrile pipe for use in oil fields and industrial plants, for water systems and gas distribution. Initial equipment includes four extruders. Pipe sizes up to 12-in. diameter will be produced. Long-range plans also call for the production of plastic-lined steel pipe.

The company will sell nationally through wholesalers of hardware, plumbing supplies, pumps, and oil field equipment.

Walter S. Prendergast, until recently vice president and general manager of Carlon Products Corp., is president. Rom Rhome, former southwestern sales manager of Carlon, is vice president; his duties will include both sales and financial management. W. F. Rippetoe, also named vice president, will supervise the sale of the firm's irrigation products on the High Plains and will be in general charge of the operations of United's subsidiary, High Plains Irrigation Supply Co.

Enters cast acrylic field

Larc Products, Inc. has recently been formed to engage in the production of cast acrylic sheet in a 169,000-sq. ft. plant at Amsterdam, N. Y. Tradenamed Larcrylic, the sheet will be produced in clear, white, and colors in standard sizes from 48 by 48 to 100 by 120 in., 0.06 to 0.375 in. thick.

National sales are to be handled through distributors and, although the basic organization has been established, certain territories are in the planning stage and yet to be developed.

New packaging material

Fungicide-treated industrial paper material that uses polyethylene as a moisture-vapor barrier is now available from Cincinnati Industries, Inc., Lockland, Cincinnati, Ohio. The material, designated X-Crepe N (a cross-creped heavy-duty paper with all-directional stretch), is said to be waterproof and grease resistant. Polyethylene is laminated between two plies of the paper which is then coated on one side with polyethylene. The film not only acts as a moisture barrier, but also supplies a heat sealable membrane. Fungicide is applied to the paper side or exterior of the case liner.

X-Crepe N is recommended by the manufacturer for case liners and other industrial uses wherever a strong, cloth-like, stretchable, bacteriostatic, polyethylene-coated material is required.

Mold release agent

A brushable coating, Coverlac SC-242C, is being offered by Spraylat Corp., 1 Park Ave., New York, N. Y., for the following applications: 1) mold release for epoxy resin laminates on plaster molds; 2) barrier release coating on metals against epoxy or other adhesive resins during bonding operations; and 3) masking metal surfaces during spraying and baking cycles.

According to the company, the compound air dries and forms a waterproof, chemical-resistant film which has good heat resistance and is readily removed by peeling from the formed part. The coating not only permits the formed part to be removed from the mold, but also acts as a moistureproof sealer on plaster molds. The same compound is also available in a sprayable consistency designated Coverlac SC-242C-1.

S.P.I. Section elects

Boston and Providence Section of The Society of the Plastics Industry, Inc. has elected the following officers for 1957: chairman—Arthur A. Staff, Koppers Co., Inc.; vice chairman—William J. Monohan, Seamco Chemical Co.; secretary—Ted Underwood, Standard Tool Co.; treasurer—Frank Dooley, H. Muehlstein & Co.; and directors—James Cushing, Morningstar Corp.; Robert Evans, Farrington Mfg. Co.; and John Adamaitis, Beacon Products Corp.

New catalysts

Pilot plant quantities of trimethyl aluminum are now being produced by U. S. Industrial Chemicals Co., Div. of National Distillers Products Corp., 99 Park Ave., New York, N. Y. The material has possible applications as a polymerization catalyst, as an in-

FEWER REJECTS—HIGHER RESIDUAL STRENGTH PROVED

... in production run of Vacuum Formed Door Liners with

MONSANTO LUSTREX Styrene Plastic

Here is a doubly critical operation of sheet extrusion and final vacuum forming of impact-proof refrigerator door liners. Quality requirements for these finished liners are high! The raw material must extrude sheets that are easily vacuum formed into complex die shapes. At the same time, cycles must be rapid. The refrigeration end use requirement demands an odor-free styrene. But most important, high vacuum forming temperatures cannot affect basic strength of the finished door liners! These are rigid specs for any material.

In a recent run of 7,350 liners, Lustrex Hi-Test 88B met and exceeded these requirements. Paul Schmidt, Chief Thermoplastic Engineer of the Panelyte Division of St. Regis Paper Co., reports, "Working with extremely complex dies, sheets extruded from Lustrex Hi-Test 88B give us excellent resilience and constant flow regardless of high heat cycles ranging from 350°-500°F. In addition, resultant strength characteristics are maintained at a steady peak level." The finished vacuum formed Lustrex liners also pass the "slam door test"—an over-loaded door slammed shut thousands of times to simulate years of actual use. Performance like this cuts rejects at the assembly level to a fine minimum ... proof again of Lustrex performance and economy.

Investigate the moldability, strength and economies of Lustrex Hi-Test 88B for your next difficult requirement. Write for complete technical data to Monsanto Chemical Company, Plastics Division, Room 1761, Springfield, Mass.

LUSTREX HI-TEST 88-B

MONSANTO

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termediate for chemical synthesis and in other uses.

A sodium-based process is used for synthesis of the trimethyl aluminum and the same basic process can be used to produce other aluminum alkyls which are used in low-pressure-processed polyolefins. Commercial quantities of the trimethyl aluminum may eventually be available for $2 to $5 a lb., although the price in pilot quantities is considerably higher.

Also available from the pilot plant is methyl aluminum sesquichloride, a mixture of methyl aluminum dichloride (CH_3AlCl_2) and dimethyl aluminum chloride ($(CH_3)_2AlCl$). This, too, may find use as a catalyst or chemical intermediate in the plastics industry.

Flame-resistant epoxy-glass

Engineered primarily for critical electrical and electronic applications, flame-resistant Stanpreg epoxy resin-preimpregnated glass cloth, manufactured by Standard Insulation Co., East Rutherford, N. J., is now being used in laminates with 83,000,000 megohm-cm. volume resistivity, 25,000,000 megohms surface resistance, and 18,000,000 megohms insulation resistance.

Stanpreg epoxy-glass is furnished in dry, non-tacky tapes or rolls. The company states that the material has uniform resin content, consistent optimum flow characteristics, and extended shelf life.

Extrusions offered

Tubes and hollow shapes extruded to exact specifications from various plastics are now available from Anchor Plastics Co., Inc., 36-36 Thirty-sixth St., Long Island City, N. Y.

Tubes may be specified from 0.020 in. inside diameter up to 3 in., with heavy or thin wall sections. Hollow shapes are obtainable in such cross-sectional designs as oval, rectangular, flanged, or keyed. Special surface effects, such as ribs, beads, or flutes, and even spiraled beads, can be designed into the inner or outer tube surface.

The extrusions are offered in rigid, flexible, hard, or soft materials in unlimited color ranges and crystal clear. They are being furnished by the company cut to exact lengths or in coils, spools, or random lengths.

Vinyl foam for Canada

An exclusive sales agreement to market vinyl foam in Canada has been completed by Canadian Resins & Chemicals, Ltd. with General Foam Corp., 640 W. 134th St., New York, N. Y., exclusive agent for all vinyl foam produced by Bolta Products Inc., Div. of The General Tire & Rubber Co., Lawrence, Mass.

General Foam's line includes standard vinyl cushioning materials and special vinyl foams of fine cellular construction. It is available in a large range of colors and in continuous rolls. Applications are rug underlay, auto and aircraft protective padding, furniture upholstery, mattress toppings, footwear, sponges, handbags, and novelties.

Expansion

Du Pont's Polychemicals Dept. is adding a three-story wing to its Experimental Station near Wilmington, Del., at a cost of approximately $1.5 million. The new laboratory wing, scheduled for completion by mid-1958, will house 18 two-man research laboratories, six offices, and a roof enclosure to accommodate special equipment.

Research activities of the Polychemicals Dept. at the Experimental Station include basic studies in the synthesis of organic chemicals and high polymers and specific work in the field af plastics, including nylon, polyethylene, acrylic, tetrafluoroethylene resins, with emphasis on new products such as Delrin acetal resin.

The Polychemicals Dept. has also recently exercised an option to purchase a plant site of about 600 acres on the Mississippi River, 27 miles upstream from New Orleans and just west of the town of Laplace, La., to provide for possible future expansion of the department's business.

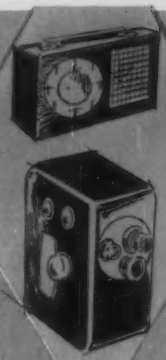
The site is known as the Belle Point plantation. The option was granted by Gulf States Land & Industries, Inc., an affiliate of the real estate firm of Webb & Knapp, Inc.

Atlas Powder Co. has broken ground for a $3 million Technical Center adjacent to its general offices at Wilmington, Del., which will enable the company to intensify its long-range basic research program, as well as to expand its technical service to the plastics industry. The Center, scheduled for completion by the end of 1957, will provide facilities for work on the entire range of applications served by Atlas products, including polyester resins, sorbitol, emulsifiers, detergents, activated carbons, and explosives.

Technical studies and product development activities now being carried on at the firm's Central Research Laboratory at Atlas Point, Del., will be transferred to the new building, along with personnel of the company's Research and Product Development Dept. who are now located in the general offices.

Atlas' Chemical Engineering Dept., which now operates pilot plant installations at the Central Research Laboratory, will take over all of that facility after the other department's move. No production or pilot plant activities will be carried on in the Technical Center.

Heyden Chemical Corp. and **Newport Industries, Inc.** have combined their assets and business. Heyden has acquired the assets of Newport and changed its name to **Heyden Newport Chemical Corp. Simon Askin** is president and chief executive officer of the new company; **Armin A. Schlesinger** was elected chairman



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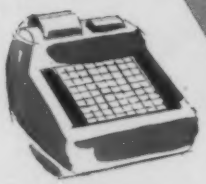

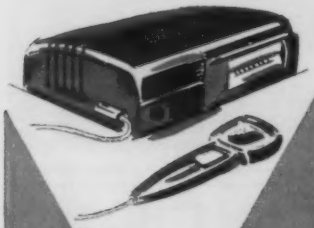

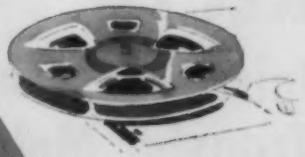

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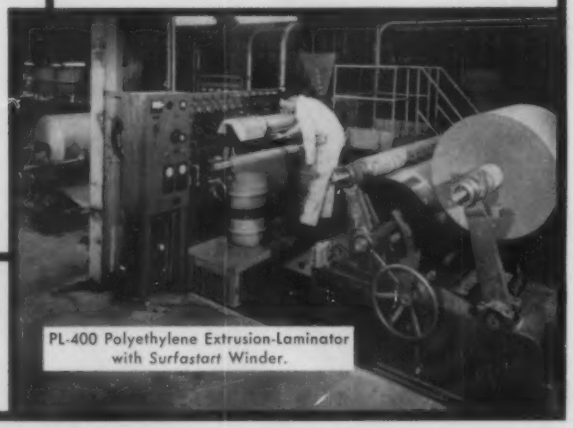

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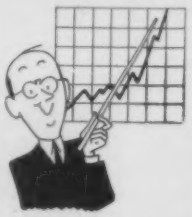

Quite frequently our technicians are called upon by fabricators to suggest means of perfecting and speeding up difficult plastic sealing operations. By intense application—by designing and building special equipment—we are most always able to raise quality as well as the rate of production.

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of the board and **John P. Remensnyder** vice chairman.

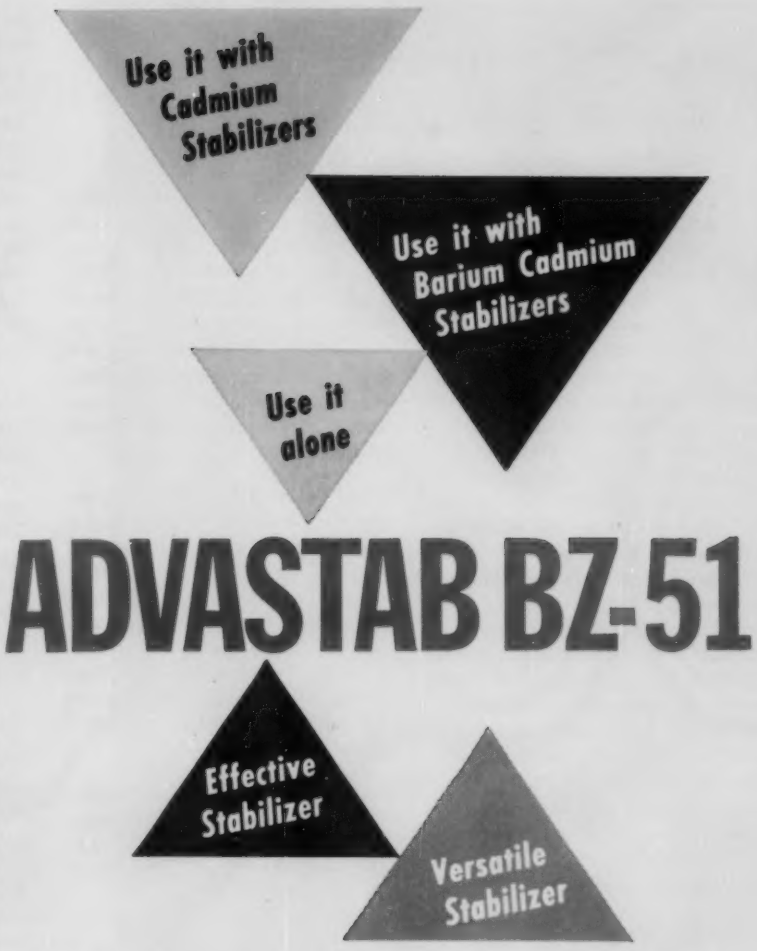
Heyden and Newport had total sales of approximately $46.5 million in 1955. For the first nine months of 1956 total sales were about $34.5 million; total assets in 1956 were $60 million.

The business of Newport will be continued under its present operating management as **Newport Industries Co.**, a division of Heyden Newport. **E. F. Sisson** is president and **S. J. Spitz** executive vice president of the division.

Heyden is a major producer of pentaerythritol, formaldehyde, and other chemicals important in the protective coatings and plastics industries. Newport is the second largest producer of naval stores and a pioneer producer of tall oil products and fine chemicals from wood sources.

Mr. Askin, who joined Heyden in 1943, has been president since 1952 and a director since 1948. He is chairman of the executive committee of **Nuodex Products Co.**, a division of Heyden, and chairman and director of **Nuodex International, Inc.** and **American Plastics Corp.**, Heyden subsidiaries. Mr. Askin also is treasurer and director of **St. Maurice Chemicals, Ltd.**, of Canada, and a director of **Salicilatos de Mexico, S.A.** Mr. Schlesinger was chairman of the board of Newport Industries and is a director of Square D Co. Mr. Remensnyder, with Heyden since 1920, has been chairman of the board since 1952. He is chairman and a director of St. Maurice Chemicals, Ltd. and a director of Nuodex International and American Plastics. From 1950 to 1952, Mr. Remensnyder was president of Heyden and from 1944 to 1950 vice president in charge of sales.

The Borden Co.'s Chemical Div. is doubling the size of the manufacturing plant in its **Resinite Dept.** at Santa Barbara, Calif., making it one of the country's largest producers of vinyl extrusions. The addition of 36,000 sq.



One of the most versatile and effective vinyl stabilizers yet developed, **ADVASTAB BZ-51** *can be used in a number of ways to achieve these outstanding results:*

- **Absolute protection from staining even under severest H_2S exposures — BZ-51 used alone**
- **Long term superior heat stability and absolute protection from H_2S staining — BZ-51 with boosters ADVASTABS E-82 or CH-201**
- **Maximum heat stability with adequate protection from H_2S staining — BZ-51 coupled with Barium-Cadmium stabilizers such as ADVASTABS BC-74, BC-12, BC-105 and BC-147**
- **Outstanding initial color and clarity — BZ-51 coupled with Cadmium stabilizers such as ADVASTABS C-77, C-79 and JCX.**

Samples and technical data are available.

Write to:

The Plastiscope

ft. of plant space will allow a production increase of about 65 percent. This expansion is in addition to the recently announced new plant in Leominster, Mass.

The company states that besides expanded manufacturing capacity, the new addition will provide a more extensive research and development department and increased facilities for compounding raw plastic materials. It will make Resinite one of the major sources of PVC compounds for other plastic extruders and molders, as well as for the wire and cable industry.

Resinite recently broadened its markets by specializing in vinyl chloride profile shapes and custom extrusions. The present line consists of garden hose and flexible sprinklers, electrical insulation tubing, medical tubing and sleeving, tapes and cords for the military services, and for the aircraft, electronic, and other industries.

Resistoflex Corp. has completed a new addition to its main plant at Roseland, N. J., which is expected to double the company's production capacity. Plant personnel has been increased to over 400, about double the previous total.

Resistoflex manufactures fluorocarbon-based Fluoroflex-T hose used in jet aircraft engines, guided missiles, and many other industrial applications.

American Hard Rubber Co. has purchased the entire capital stock of **Electric Mfg. Co., Inc.**, San Francisco, Calif. Electric has developed and is the country's leading manufacturer of multicolor plastic moldings for industry. Products include telephone dials, key buttons for business machines of all types, and indicating dials for recording and other instruments. There will be no change in management.

The acquisition of Electric represents another step in American Hard Rubber's plans for expanding and diversifying its business. Other subsidiaries of American Hard Rubber are **Ace Comb Co.**; **Gavitt Wire & Cable Co.**; **Supplex Co.**, producer of plastic lawn sprinklers, garden hose, and plastic pipe; and **Pequanoc Rubber Co.**, producer of reclaimed rubber and custom compounds for industry.

Texas Eastman Co., Div. of Eastman Kodak Co., announces that a further increase in the capacity of its Tenite polyethylene manufacturing facilities brings total capacity of the Longview, Texas, plant up to 55 million lb. annually. This is the second increase in capacity at the Texas plant since commercial deliveries were begun late in 1954.

The Wooster Rubber Co., Wooster, Ohio, producer of houseware and automotive products, has purchased the plant, equipment, and inventory of Jamestown Finishing Products, Inc., Jamestown, N. Y., and will operate it as a wholly-owned subsidiary under the name of **Jamestown Finishes, Inc.**

James R. Caldwell, president of Wooster Rubber, will serve as chairman of the board of the Jamestown firm; **Ben W. Avallone** and **L. D. Anders** have been named president and vice president, respectively, of the subsidiary.

Jamestown Finishes employs 75 persons in the production of plastics, plastic paints, baked enamel finishes for industrial users, and special plastic coatings for fabrics and wire products. Jamestown Finishing Products had been a major supplier for plastic dips used by Wooster in the production of its Rummermaid line of dish drainers and other coated wire items.

Newark Paraffine & Parchment Paper Co., 50 Jelliff Ave., Newark, N. J., has purchased new office and manufacturing facilities on Blanchard St., Newark. Located on a 22-acre site and providing 135,000 sq. ft. of floor space, the new premises more than double the area of the present plant.

The company produces protective papers and its operations include printing; waxing; coating; multiple laminating of foil, paper, and films; and manufacture of barrier materials meeting government specifications. Plans call for production to start on the new premises by July 1957.

Imperial Chemical Industries Ltd. announces that it will increase production of Terylene polyester fiber to 30 million lb. a year by extending sections of its Terylene plant at Wilton in North Yorkshire, England. (Terylene is I.C.I.'s equivalent to Du Pont's Dacron.) Present production rate is 22 million lb. a year; the additional output is expected to be available early in 1959.

Molded Fiber Glass Research Co., a new company jointly owned and supported by the five **Molded Fiber Glass Companies**, has completed a 6000-sq. ft. building at 4826 Benefit Ave., Ashtabula, Ohio, which will house research and engineering facilities for the five affiliated organizations.

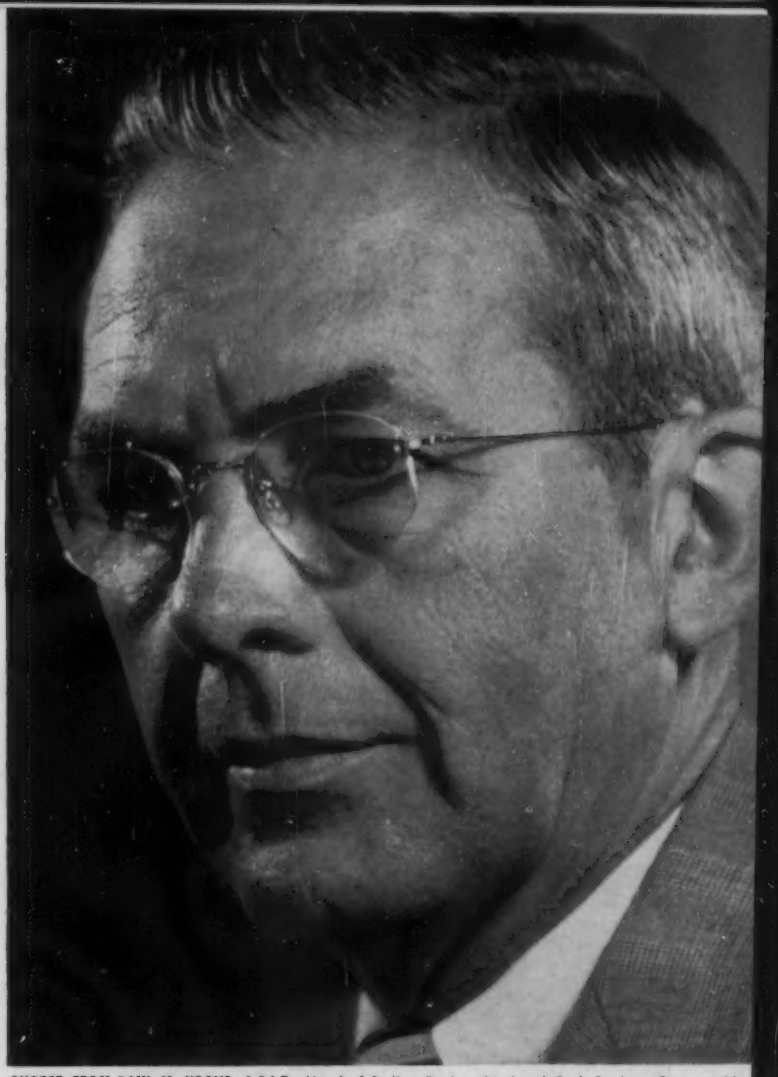
The new facility is designed as a centralized laboratory for research and testing work on raw materials, processes, and finished products in the field of fibrous glass-reinforced polyester resins. Experimental and development work in other reinforcements and resins, as well as equipment and process engineering, will also be done.

E. R. Garretson, formerly in charge of technical development work for several of the Molded Fiber Glass Companies, has been named director of research of the new company.

Nicholson File Co., Providence, R. I., has purchased the assets of **The Danielson Mfg. Co.**, Danielson, Conn., maker of molded and extruded nylon products for industrial uses. Danielson, which will operate as a Nicholson subsidiary, will continue to operate under its present management;

Colorful, easily molded Styron reproduces this handsome pitcher with complete fidelity to detail.

Sleek good looks and function without bulk mark these double-walled thermo-tumblers molded of Styron in decorator colors.



QUOTED FROM PAUL M. KOONS, A.S.I.D., Head of Styling Design, National Cash Register Company**

abreast of changes: industrial designers and Styron

"Keeping abreast of changes in materials . . . is the responsibility of the (industrial designer's) art."

To keep abreast of changes in materials, keep in touch with the company that paces the industry in new developments. Dow leads in introducing new polystyrene materials and now offers eleven different Styron® (Dow polystyrene) formulations.

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Many changes in methods are pioneered by Dow. A recent example is the "plug-assist" technique for vacuum-forming sheet plastics. To keep abreast of such developments in methods, write us for technical literature.

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Hand in hand with good taste goes the knowledge that improves product performance. Our understanding of the relationship between designer, fabricator and supplier can help you express your good taste with products of top performance.

We invite you to contact us for help in meeting the challenge of today's dynamic plastics industry. Whether your problem concerns material, tooling or product application, our experience and facilities are as near as your phone or your mail box. THE DOW CHEMICAL COMPANY, Midland, Michigan—Plastics Sales Department PL1548L.

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- STYRON 689 (Easy Flow)

HIGH IMPACT
- STYRON 475
- STYRON 429 (Extrusion)
- STYRON 777 (Medium Impact)
- STYRON 440 (Heat Resistant)
- STYRON 480 (Extra High Impact)

HEAT RESISTANT
- STYRON 683
- STYRON 700

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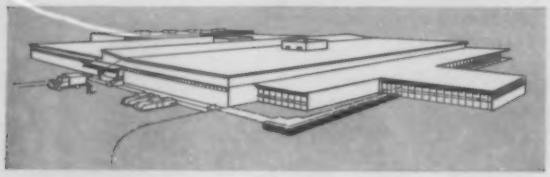

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its line includes nylon gears, threaded fittings, tubing, nylon-coated cable, and nylon-faced hammers, manufactured under the tradename Danco.

Nicholson management plans to continue the manufacture of Danco products in enlarged plant facilities at Danielson.

Beaver Paint Co., Inc., manufacturer of specialized production coatings for the plastics industry, has moved from Beaver Falls, Pa., to new and enlarged quarters at Lake City, Pa., which provide an area of 12,000 sq. feet.

Additional production equipment has been added through the purchase of all physical assets of **Gibbs Paint Co.**, Cleveland, Ohio. The firm manufactures specialized production coatings for the plastics industry.

Deceased

James C. Clinefelter, 64, midwest representative for John Royle & Sons, died in Akron General Hospital after a brief illness. He had been midwest representative for the company, extruder builders, since 1929. Mr. Clinefelter's sons, Robert C. and James W., will continue to represent John Royle & Sons in the area.

Meetings

Plastics groups

March 18-21: The Society of the Plastics Industry, Inc., S.P.I. Annual National Conference, Los Angeles-Biltmore Hotel, Los Angeles, Calif.

March 18-21: The Society of the Plastics Industry, Inc., Pacific Coast Plastics Exposition, Shrine Exposition Hall, Los Angeles, Calif.

April 3: Society of Plastics Engineers, Inc., Regional Technical Conference, New York, N. Y. Subject: "Plastics for Building."

April 4-5: The Society of the Plastics Industry (Canada), Inc., Fifteenth Annual S.P.I. Canadian

NEW ECONOMY TIP

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Union HONEYCOMB sandwich core is as practical and versatile a material today as plastics themselves. Reason? This expanded cellular paper core, laminated between plastic sheets or "skins", is one of the strongest structures known for a wide variety of applications. And on a square foot basis—the most economical.

The lightweight, fewer component parts of Union HONEYCOMB save you shipping expense — speed fabrication — lower labor costs.

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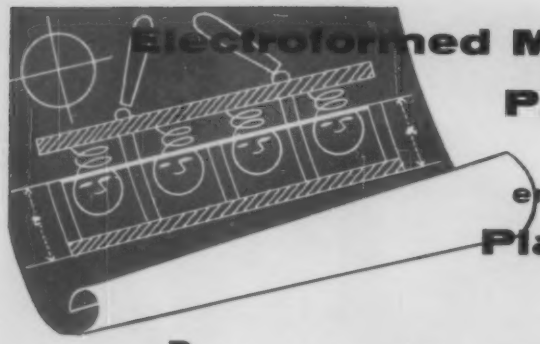

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Plastiplate molds accurately reproduce the most intricate design and detail—including slush molds, multiple and individual closures for rotational casting, with special "Releasealloy"® for easy stripping. You can rely on Plastiplate for your vacuum forming molds, too.

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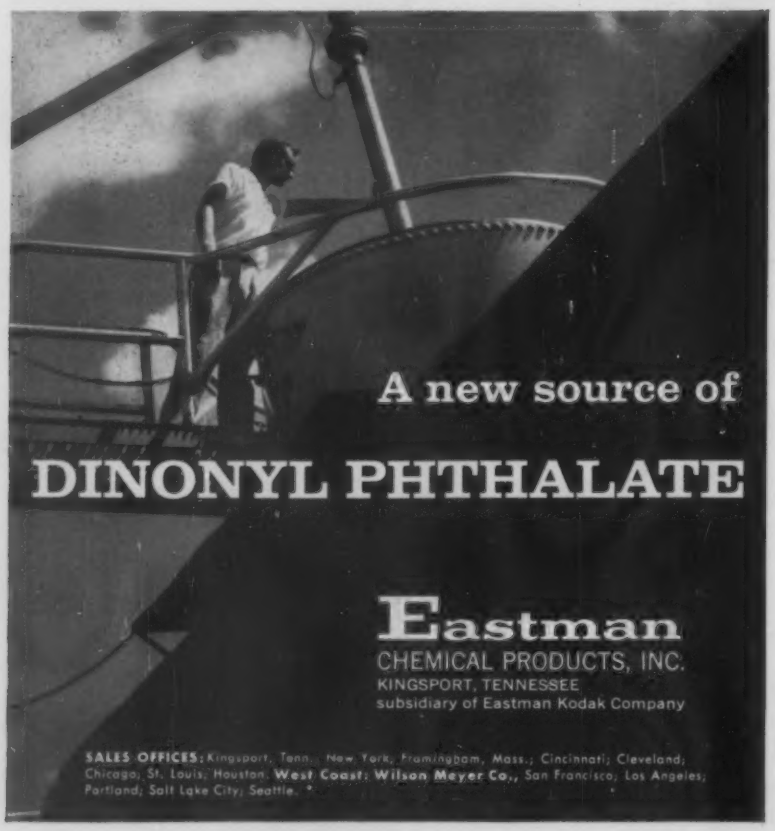
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subsidiary of Eastman Kodak Company
SALES OFFICES: Kingsport, Tenn.; New York; Framingham, Mass.; Cincinnati; Cleveland; Chicago; St. Louis; Houston. West Coast: Wilson Meyer Co., San Francisco; Los Angeles; Portland; Salt Lake City; Seattle.

Conference, Hotel Chateau Laurier, Ottawa, Ont.

June 14: Society of Plastics Engineers, Inc., Regional Technical Conference, M.I.T., Cambridge, Mass. Subject: "Plastics for Electronics."

Other meetings

March 12-13: Chemical Market Research Association, Meeting, Sheraton Hotel, Philadelphia, Pa. Theme: "Our Next Five Years of Competition with Foreign Chemical Industry."

March 23-28: American Society of Tool Engineers, Silver Anniversary Technical Meeting and Convention, Shamrock Hilton Hotel, Houston, Texas.

March 27-28: Commercial Chemical Development Association, Honor Award and Annual Meeting, Statler Hotel, New York, N. Y.

April 8-11: American Management Association, Twenty-Sixth National Packaging Exposition, International Amphitheatre, Chicago, Ill.

April 8-12: Manufacturing Chemists' Association, Inc., Chemical Progress Week.

May 13-14: Commercial Chemical Development Association, Annual Resort Meeting, French Lick, Ind.

May 14-16: Armour Research Foundation of Illinois Institute of Technology and *Nucleonics* Magazine, Second Annual Industrial Nuclear Technology Conference, Museum of Science and Industry, Chicago, Ill.

June 9-12: American Institute of Chemical Engineers, Meeting, Olympic Hotel, Seattle, Wash.

July 7-11: Independent Housewares Exhibit, Inc., Ninth National Independent Housewares and Home Accessories Exhibit, Convention Hall, Atlantic City, N. J.

July 10-20: International British Plastics Exhibition, Grand and National Halls, Olympia, London, England. Additional information may be obtained from John L. Wood, British Plastics Exhibition, Dorset House, Stamford St., London, S.E.1, England.

Companies . . . People

Hercules Powder Co., Inc.—Cellulose Products Dept.: Carl W. Eurenius, assistant general manager of the department, named assistant general manager of the Paper Makers Chemical Dept. **Werner C. Brown,** director of sales for the department since June 1955, appointed assistant general manager to succeed Mr. Eurenius. The Cellulose Products Dept. includes general supervision of Hercules' plastics materials. The changes are in conformity with a long-range management program of shifting key executives across departmental lines. Other changes in the department are: **J. B. Martin,** formerly supervisor of plastics promotional activities, transferred to the Export Dept. to develop export plastics markets; **Robert C. Clark,** previously manager of the Cincinnati office, transferred to Wilmington to aid in plastics sales and promotional work; **Gregory N. Bruxelles,** on the sales development staff, named manager of the Cincinnati office. **J. J. Coughlan** transferred to the Boston district as a technical sales representative for plastics, **C. A. Borton** to the New York office, and **Vincent E. Walsh** to the Cincinnati district office.

Synthetics Dept.: Frank G. Oswald, named industry sales manager, responsible for the protective coating; printing ink; and food, drug, and cosmetic industries. **J. G. Little** appointed sales manager of Polyols, responsible for the sales, promotion, and technical service of mono- and technical pentaerythritols. **Dr. J. W. Kneisley** now sales manager, Oxidation Products, in charge of sales, promotion, and technical service of dimethyl terephthalate, dimethyl isophthalate, and methyl toluates.

Hawthorn Chemical Corp. (recently formed by Hercules and I.C.I. for the production of methyl methacrylate in the United States): **James W. Cleary** named works manager of the methyl methacrylate plant to be built at Louisiana, Mo. **Geoffrey Ainsworth** and **Robert L. Stowell,** formerly senior design engineers with Imperial Chemical Industries, Ltd. in England, have joined Hawthorn and, together with Mr. Cleary, are working with the Hercules Engineering Dept. on the layout, design, and construction of the new plant.

Union Carbide—Bakelite Co.: J. L. Rodgers named manager, Molding and Extrusion Materials Dept.; **A. F. Sward** now manager, Bonding Materials Dept.; **J. B. Knowles** appointed manager, Consumer Products Dept. **J. W. McLaughlin,** with Union Carbide since 1941, promoted to manager, Film and Sheeting Div. He was formerly assistant manager. **Howard L. Burpo,** with Bakelite since 1945, appointed eastern zone manager for the Film and Sheeting Materials Div. and will direct the sales of plastic film and sheeting materials for Bakelite in the Eastern Seaboard area from Maine to Florida. **J. P. Raycob,** named technical representative for the Film and Sheeting Materials Div., takes over the sales district formerly served by Mr. Burpo. **C. O. Schwahn,** technical representative of the Surface Coatings Div. since 1946, now product specialist for latex materials, will be concerned with these materials as they relate to surface coatings.

Carbide and Carbon Chemicals Co.: L. W. Newton, with Union Carbide since 1941, appointed assistant to the vice president of research. **J. Lee Marsh,** with Union Carbide since 1933, now vice president of development; he will be responsible

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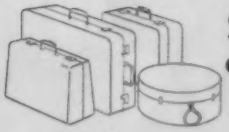

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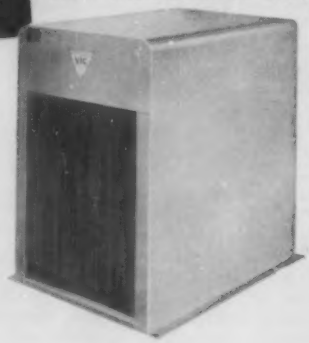

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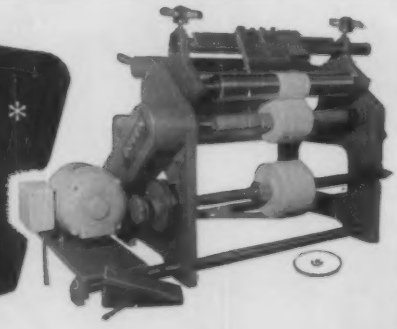

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Companies . . . People

for the Development Dept. of the Chemicals company as well as for all phases of its textile fibers activities. **H. B. Coons**, with Union Carbide since 1933, named superintendent of the Niagara Falls plant. **G. W. Cochrane** assigned as technical representative for the Sales Dept. to the San Francisco district; **C. G. Herion** to the Los Angeles district. **Gordon W. McBride**, chemical engineering consultant, has joined the Washington, D.C., staff of Carbide and Carbon as technical coordinator; he will provide liaison between Carbide and Carbon Chemicals Co. and government research agencies and laboratories. Mr. McBride has been in consulting practice in Washington with his father, Russell S. McBride, since 1939, except during World War II.

Brea Chemicals, Inc.: James G. Baldwin appointed manager of industrial chemical sales in a move to expand this division to handle the national marketing of Brea polyethylene resins. Regional sales offices in Chicago and New York are expected to be opened soon, with **John J. Keville** as regional sales manager in the east and **James L. Todd** midwest regional sales manager. Mr. Baldwin was formerly with Pennsylvania Salt Mfg. Co. Mr. Keville's affiliations were with Standard Pyroxoloid Corp. as general manager of the Plastics Products Div. and the Plastics Div. of Celanese Corp. of America.

Monsanto Chemical Co.—Plastics Div.: E. S. Brockney named assistant sales manager for Polyflex-100 oriented polystyrene film and sheeting. (Polyflex-100 was recently added to the division's line through an exclusive distributorship agreement with **Plax Corp.**) **George O. Langlais** now with the Technical Service Dept. **Charles S. Cheston, Jr.** has joined the sales staff. **James R. Hopkins** to the Engineering Dept. and **Howard B. Kreider, Jr.** to the Research Dept. **F. A. Sherwood**, associate director of engineering at Texas City, Texas, will head up a special project to locate and evaluate sites for new petrochemical and polymer operations.

United States Plywood Corp.: Chicago branch opened for **Barash Co. Div.**, converter and finisher of vinyl and other plastics. **Roy Faulkner** will be in charge of the branch. Barash's line includes Vitalon and Kalistron clear vinyl plastics, with color fused to the underside, used in the luggage, wall covering, and upholstery industries; another product is Barahyde, a coated saturated paper used in bookbinding. The

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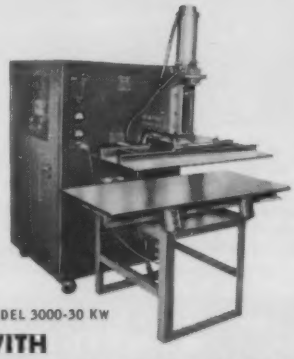

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branch will also market vinyl-surfaced Flexwood, originally developed as a decorative hardwood veneer, and now being introduced to the luggage trade. Experiments are under way for the use of the material in the manufacture of women's shoes, belts, and other accessories.

The Dow Chemical Co.: Gage Olcott appointed head of the merchandising section of plastics sales, succeeding **Amos L. Ruddock**, recently named manager of the company's Textile Fibers Dept. **Dr. David H. Morgan**, former president of Texas A and M College, appointed director of College Relations for the company. An important function will involve liaison with institutions of higher learning to encourage industry-education cooperation for the advancement of science and engineering and to stimulate student interest in the various scientific fields.

Soule Co., Inc., Tampa, Fla., **The Badham Sales Co.**, Atlanta, Ga., and **The James A. Madden Co.**, Billings, Mont., named distributors of Styrofoam, Dow's rigid styrene foam.

Du Pont: Dr. John O. Punderson, research chemist in the Polychemicals Dept. at the Experimental Station, Wilmington, Del., promoted to research supervisor. He will direct studies on Delrin acetal resin, Du Pont's new plastic.

The patent section of the Research Div. of the Polychemicals Dept. has been set up as a separate division to be known as **Patents and Contracts Div. Allen R. Plumley** will continue as manager of the new unit; **Ambrose A. McAlevy**, formerly assistant manager of the patent section, is now assistant manager of the division. There will be no change in the duties or personnel of the organization.

The General Tire & Rubber Co., Textileather Div.: Two separate departments established, one handling sales to shoe manufacturers and the other servicing the luggage and leathergoods fields. Formerly, the complete activity was under the direction of **Thomas P. Bargmann**, assistant sales manager, who now heads the shoe sales section, assisted by **Robert E. Borden**, assistant product manager. Heading the luggage and leathergoods section is **John L. Howald**, product manager, assisted by **Charles R. Davis, Jr.**

Goodyear Tire & Rubber Co.: Joseph E. Mayl, vice president, general products group, retired after 33 years with the company. He is succeeded by **Sam DuPree**, general manager of the Industrial Products Div. Mr. DuPree will be responsible for coordinating activities of the company's Industrial Products, Aviation Products, Metal Products,

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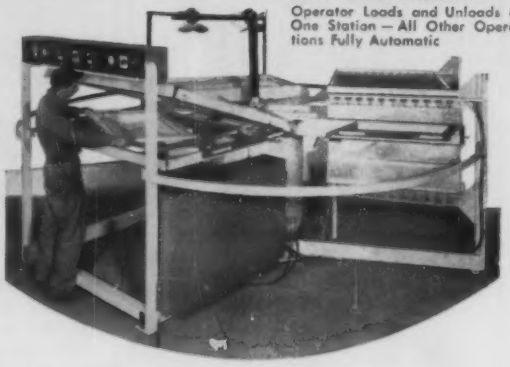

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Progress in Plastics

Companies . . . People

Shoe Products, Foam Products, Film, and Flooring Di s., and the Government Sales Dept. **R. B. Warren,** former sales manager, Industrial Products, appointed to the post vacated by Mr. DuPree.

Allied Chemical & Dye Corp.— Solvay Process Div.: Harold F. Merritt, vice president, retired after 43 years with Solvay. **Lester B. Gordon,** vice president, with the division since 1915, appointed head of the sales organization.

National Aniline Div.: William J. Urbowicz named product manager of alicyclic chemicals; he will be concerned with promotion of caprolactam, adipic acid, cyclohexanol, cyclohexanone, hydroxylamine, ammonium sulfate, and nylon molding compounds (in liaison with the Barrett Div.).

Nopco Chemical Co., Plastics Div.: R. W. Ward, formerly plant engineer, will be in charge of all engineering and production at the new North Arlington, N.J., plant. **Harry Marx** will be responsible for urethane foam production. **Harry Rogers,** in charge of production during the initial phases of setting up the new operation, will take over responsibility for the company's flexible foam program.

Formation of a new laboratory has been announced. Operating under **Dr. M. J. Kelley,** director of the Industrial Specialties Laboratories, and chief chemist **Henry R. Thompson,** the new unit will be responsible for an accelerated program of evaluating new chemicals as vinyl stabilizer components. The company, through its subsidiary **Metasap Chemical Co.,** produces vinyl stabilizers.

The Borden Co., Chemical Div.: Raymond J. Lodge named general manager of the Resins and Chemicals Dept. and **Charles W. Smith** general manager of the Polyco-Monomer Dept. **Eugene J. Sullivan,** formerly top administrator for both departments, promoted to vice president and general manager of the entire division.

Tri-Point Plastics, Inc. is the new name of the combined divisions of the Tri-Point group of companies. Situated now in its new 14,000-sq. ft. plant in Albertson, N.Y., Tri-Point specializes in extrusion of TSI Teflon (a Tri-Point tradename designating tolerance, strength, and insulation) and machining and processing all industrial plastics into precision component parts. The former names of the Tri-Point groups were Tri-Point Mfg. & Developing Co., Tri-Point Manufacturing, Inc., and Tri-Point Insulation, Inc. The new name will also apply to the **Electronics Div.,** producing Trinseel sub-miniature Teflon-insulated terminals, which was recently added to the group, as well as another division now in formation.

Under the new corporate organization, **Sal Mulay,** formerly one of three principal owners, becomes president; **Jack Kipnes,** another principal, is secretary and treasurer; and **Pat Ruggieri** retains his post as director of sales.

Foster Grant Co., Inc.: F. William DeBree, former general sales manager of American Plastics Corp., now eastern sales representative. **Dr. Conrad C. Bruschweiler,** Bern, Switzerland, awarded the Foster Grant post-doctoral fellowship in chemistry at the University of Notre Dame. Dr. Bruschweiler is carrying on research in polymer chemistry under **Prof. G. F. D'Alelio,** head of the university's Chemistry Dept.

Sylvania Electric Products, Inc., Parts Div.: J. Richard Krapfel, formerly sales manager of the Chicago office, appointed product sales manager of electronic components. He will represent plastic components,

such as electronic tube sockets and fluorescent wiring devices, manufactured by the division for the radio, television, and lighting industries.

New sales office opened at 7800 Intervale Ave., Detroit, Mich. **Charles W. Morrison** is divisional sales representative for custom molded plastics, electronic components, metal stampings, bare fine wire, etc. **William C. Mader** named field sales representative for the Chicago office.

National Starch Products: Jerome Stern and **Charles J. Steed, Jr.** promoted to sales supervisors for the East and Midwest, respectively, for the Resin Div.

Hooker Electrochemical Co.: Dr. Clarence A. Stiegman, named director of product development, will direct product development of both the chemical and plastics elements. He was vice president and technical director of Oldbury Electro-Chemical Co. prior to its consolidation into the Hooker organization late last year.

Archer-Daniels-Midland Co.: Formation of a resin and plastics division has been announced. **W. G. Andrews,** assistant vice president, is manager and **W. C. Mueller** assistant manager. **E. W. Kaufmann,** formerly regional manager in charge of the territory served by the Philadelphia sales office, appointed sales manager for resins. **Fred J. Burnett,** former sales manager of Glyptal resins for General Electric Co., who joined ADM recently after it purchased rights to manufacture Glyptal resins, is sales manager for industrial resins.

Boonton Molding Co., Boonton, N.J., was awarded the grand prize by S.P.I. for the best informative label of 163 entries identifying a plastic product for consumers during 1956. The company won the prize for its hangtag for Boontonware melamine dishware.

Victory Mfg. Corp.: Harold L. Samuels, formerly with Chicago Molded Products, named executive vice president. **Edward F. Abbott,** general manager for the past few years, appointed a vice president. Victory is a custom injection molder.

Armstrong Cork Co.: Roy A. Horning, assistant general manager and production manager of the Glass and Closure Div., retired after 42 years with the company. **Roger H. Hetzel,** with the company since 1935, appointed new assistant general manager, in addition to his present responsibilities as general sales manager. **W. W. Pedrick III,** manager of the Millville, N.J., plant, succeeds Mr. Horning as production

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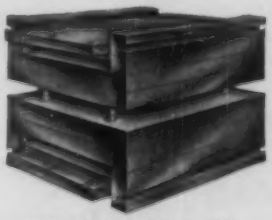
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Companies ... People

manager of the Glass and Closure Div. **Roger F. Scott,** assistant plant manager at Millville, named to succeed Mr. Pedrick as plant manager there. **Walter W. Sheridan,** chief industrial engineer for Armstrong industrial products plants, succeeds Mr. Scott.

The Stanley Chemical Co.: E. McKendree Hayden appointed special assistant to **William H. Baldwin,** president. Mr. Hayden, who remains a vice president and director of the company, will be responsible for the development of new products, especially in the fields related to plastics. He has been one of the pioneers in the development of plastisols and organosols. **Robert F. McTague** succeeds Mr. Hayden as technical director. **Walter W. Tesch** named sales representative for southern New Jersey, southeastern Pennsylvania, and greater Philadelphia areas.

Pro-phy-lac-tic Brush Co., Plastics Div.: Eric Stahlberg, Jr. named production superintendent. He will be responsible for all operations in reinforced plastics, thermosetting molding (including tableware), injection molding, and metallizing, which includes all proprietary molding for Pro-phy-lac-tic Brush Co. and all custom molding activities for Prolon Plastics. **Fred Corbett** will continue as general foreman of thermosetting molding. **Fred Grinnell** becomes general foreman of all injection molding departments.

DeBell & Richardson, Inc.: Herbert S. Schnitzer appointed to head newly formed compounding and pilot plant group. **W. J. Eakins** named specialist in polyesters.

General Industries Co., Plastics Div.: W. E. Foster and **Carl Russert** named vice presidents. **Morris Barchard** promoted to manager of the division and **C. M. Norris** to assistant manager. The division specializes in custom molded plastics.

Plax Corp.: Howard A. Scopp, previously with Olin Mathieson Chemical Corp., now manager of polymer chemistry in the Research Dept. **William R. Bolton,** with the company since 1947, promoted from New York district manager to the newly created post of eastern regional manager.

National Research Corp.: The name of National's continuous vacuum metallizing subsidiary, **Foiltone Products, Inc.,** has been changed to **NRC Vaculite Corp.** The company

succeeds Mr. Horning as production | Branches in Hillside, N.J., Chicago, Ill., Cleveland, O. & Los Angeles, Calif.

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produces metallized plastic film. **NRC Equipment Corp.** is the new name of the Equipment Div. under the direction of **S. S. Minault.** The division sells high vacuum process equipment and specialized components.

Ciba Co., Inc., Plastics Div.: G. M. Scales promoted to technical sales manager; **Elliott N. Dorman** becomes assistant technical sales manager; **J. B. Durra** named advertising and sales promotion manager.

Ciba Pharmaceutical Products, Inc.: Lawrence H. Zahn, manager of the Methods and Package Development Div., has been granted a six months' leave of absence to serve as deputy director of the Containers and Packaging Div. of the Business and Defense Services Administration of the United States Department of Commerce.

Minnesota Mining & Mfg. Co., Reinforced Plastics Div.: Reynolds Marchant, with the firm since 1931, named consultant for electronics research. **Ward B. Sanford,** with 3M since 1949, appointed eastern sales representative, with headquarters at the Ridgefield, N.J., branch office.

W. R. Grace & Co.—Polymer Chemicals Div.: Berndt K. Lyckberg, formerly manager of the chemical laboratories of Firestone Plastics Co., appointed general manager of the new high-density polyethylene plant in Baton Rouge, La.

Dewey and Almy Chemical Co. Div.: Edward L. Mears named manager of the Central Services Div. He will be in charge of industrial relations, public relations, advertising, purchasing, and market research.

Synthane Corp. has established new and expanded western headquarters at 1260 South Central Ave., Glendale, Calif., comprising 7200 sq. ft. of warehouse and office space. Western representative is **Bert C. Kibre.** The company produces thermosetting laminates.

Mobay Chemical Co.: L. Dean Tyler named manager of the eastern sales district; **Philip J. Lowry** appointed manager of the Akron sales district. **Ray Edward Bolin, Jr.** is leaving for Europe on a six-month period of training in urethane foam technology at the plant laboratories of **Farbenfabriken-Bayer, A.G.,** Leverkusen, Germany.

Lincoln Molded Plastics, Inc. has taken over the **Lincoln Plastics Corp.** custom injection molding operation at Circleville, Ohio, in a transaction involving a transfer of physical assets and property. Lincoln Plastics Corp. will continue in the manufacture and sale of plastic wall tile from its new head-

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quarters at 60 E. 42nd St., New York, N.Y. Personnel and management policy at Circleville will be unchanged. Management of Lincoln Molded Plastics will be conducted by **M. W. Burkhart,** now vice president and director of Lincoln Molded Plastics.

Nyotex Chemicals, Inc. and **New York-Ohio Chemical Corp.,** subsidiaries of **Stauffer Chemical Co.,** have been integrated into the parent company and will operate as **Nyotex Chemicals Div.** and **Industrial Chemicals Div.,** respectively.

Nyotex will produce anhydrous hydrogen fluoride, aluminum chloride, antimony trichloride, and anhydrous hydrogen chloride, which are used as catalysts in polymerization and organic synthesis. They will be handled nationally by the Industrial Chemicals Div.

Industrias Quimicas Eletro Cloro, S.A., Brazilian subsidiary of **Solvay & Cie,** has been licensed by **Phillips Petroleum Co.** to use in Brazil the new Phillips-developed catalytic process for making rigid polyethylene. The parent company, Solvay & Cie, with headquarters in Brussels, Belgium, had previously been granted exclusive rights to use this process in Italy.

Popular Fibreglass Products Corp., subsidiary of **Popular Plastic Products Corp.: Leonard E. Elterman** elected president, **Walter Elterman** secretary, and **Daniel Elterman,** treasurer. **H. E. Greene** appointed general manager of the corporation.

The company also announces that it has received an order to produce reinforced plastics baby carriage bodies for **Biltrite Carriage Co.,** Brooklyn, N.Y.

Columbian Carbon Co.: Wesley C. Ekholm, formerly general manager of carbon black production at Monroe, La., promoted to newly created post of general manager of manufacturing for the Carbon Black and Pigment Div. He is succeeded by **M. R. Howell.**

Crown Tool, Inc., Wabash, Ind., is the new name of the company formerly known as Hipsher-Kastner & Jacobs, Inc. The firm makes tools, dies, and special machinery.

Shawinigan Resins Corp.: W. K. Wilson named manager of technical service, **J. A. Cooper** manager of product development, and **D. H. Fraser** manager of market research. **W. H. Bromley** and **E. H. Finsilver** appointed to the newly created posts of general sales manager and assistant general sales manager, respectively.

The Marblette Corp.: Ram Chemicals, Inc., Gardena, Calif., named new western sales and service representative. (Marblette was formerly represented in the west by Precision Tool Sales). **Bourke and Mabee,** Toronto, to represent the firm in eastern Canada. Marblette produces Maraset epoxy resins and Marblette phenolic resins for casting, laminating, surfacing, encapsulating, and plastic tooling.

Oronite Chemical Co.: H. E. Bramston-Cook elected a member of the board of directors; now vice president of the company, Mr. Bramston-Cook will be responsible for industry relations and for coordinating company policies in the eastern United States. **N. E. Hathaway** appointed to new position of general sales manager; **J. R. Stitt** named coordinator of marketing to replace Mr. Hathaway; **T. M. Welton** appointed eastern regional sales manager to succeed Mr. Stitt.

Ideal Toy Corp. announces the formation of **ITC Model Craft** as its new hobby division. (There is no connection between Ideal Toy and Ideal Aeroplane & Supply Co.

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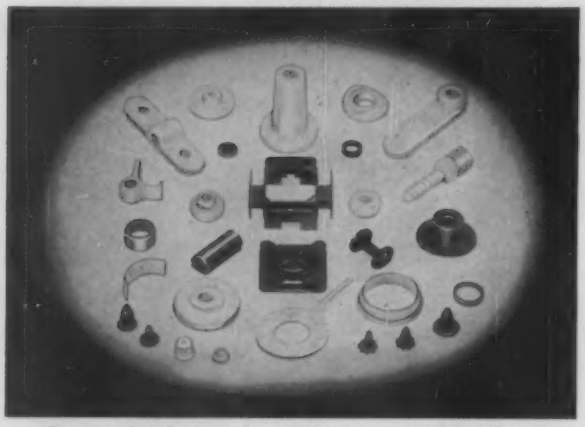

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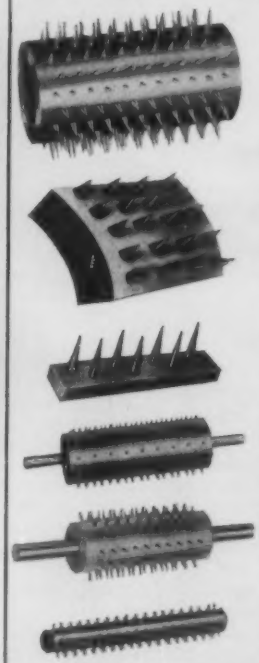

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which also makes a line of hobby toys.) This is the fourth division of Ideal Toy, the others being doll, stuffed animal, plastic toy, and inflatable vinyl divisions. The company expects to go into the hobby business in a big way.

Landers Corp.: Robert G. Landers elected board chairman; **John P. Howland,** president; **John C. Siegman,** executive vice president and treasurer; and **Timothy Y. Hewlett, Jr.,** secretary. Landers makes vinyl-coated fabrics.

Dimatec Ltda.: Companhia Paulista de Tampas (Sao Paulo Cap Co.) was recently established to produce plastic closures previously made by Dimatec's Plastics Div.

Logan Engineering Co., Chicago, Ill., will manufacture horizontal hydraulic pelleting machines, for sale in America, under license from **British Industrial Plastics, Ltd.** These machines are made in England by **B.I.P. Engineering, Ltd.,** a wholly owned subsidiary of British Industrial Plastics, Ltd.

Deutsche Tafelglas AG., Furth/Bavaria, Germany, has signed a licensing agreement with **Campco Div., Chicago Molded Products Corp.,** to manufacture and supply Campco-type styrene alloy sheet in Germany. This is the third such agreement that Campco has made with foreign companies in recent months. The agreement provides for Deutsche Tafelglas representatives to be trained in the United States by Campco, and for an exchange of ideas and machinery between the two companies.

Stull Engraving Co.: R. A. Roth, former general sales manager, named vice president and will work closely with the 70 distributors handling Stull's line of polyethylene closures throughout the United States and Canada. **Charles Bogert** assigned to sales for the Eastern Seaboard territory.

R. S. Aries & Associates have moved from 270 Park Ave. to larger quarters at 41 E. 42nd St., New York, N.Y.

Tube Turns Plastics, Inc.: Earl Erich named sales manager. **James L. Sheehy** appointed district manager of the recently established western area. The firm produces PVC fittings, flanges, and valves.

Dr. Joseph Nowotny, technical representative for **Intercontinental Chemical Corps.,** Empire State Bldg., New York, N.Y., for the past two years, has returned to Germany where he will take over new activities for the parent company, **Farbwerke-Hoechst,** Frankfurt. Dr. Nowotny has been suc-

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*Patents applied for

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ceeded in the U.S. by **Dr. Hans L. Hoyer**, who has been in this country a few months getting acquainted with the trade.

Joseph M. Gentile elected executive vice president of **Resistoflex Corp.**, Roseland, N.J. The company manufactures temperature- and corrosion-resistant fluorocarbon hose assemblies for jet aircraft engines, guided missiles, and many industrial purposes.

Frank J. Scully appointed commercial products sales manager of **Zenith Plastics Co.**, Gardena, Calif., subsidiary of **Minnesota Mining & Mfg. Co.**

F. R. Kiernan appointed vice president in charge of manufacturing of **Kurz-Kasch, Inc.**, Dayton, Ohio, custom and proprietary plastic molder.

Sigmund A. Czarnecki, formerly buyer of plastics for Westinghouse Mfg. Co., named production manager of **Worcester Moulded Plastics Co.**, Worcester, Mass.

W. Earl Dunn has joined **Blaw-Knox Co.'s Chemical Plants Div.**, Pittsburgh, Pa., as vice president and general manager.

Albert W. D'Armond, formerly with The General Tire & Rubber Co., now sales manager of **Wabash Rubber & Plastics Corp.**, Seymour, Ind., a subsidiary of **The H. O. Canfield Co.**, Bridgeport, Conn.

James H. Mendenhall appointed purchasing agent of **Precision Plastics Co.**, Philadelphia, Pa., custom molder.

Leonard Greenfield appointed vice president in charge of sales of **Metaplast Process, Inc.**, Woodside, N.Y. For the past 14 years, Mr. Greenfield has been associated in the metallizing field and has a wide knowledge of the fundamentals of metallizing on plastics.

Allan J. Greene elected to the newly created post of administrative vice president and a member of the executive committee of **Chas. Pfizer & Co.**

F. B. DuVall now president of **Fluorulon Laboratories, Inc.**, Caldwell, N.J. The company specializes in the molding and fabrication of Kel-F and Teflon fluorocarbon plastics.

Harold B. Gartner, with the firm since 1939, named vice president in charge of production for **American**

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Latex Products Corp., Hawthorne, Calif. He will be in charge of the manufacture and fabrication of the plastics, foam rubber, and adhesives divisions, and of the maintenance and engineering departments.

E. W. Fisher named manager of the newly formed **Product Engineering Dept.** of **The Garlock Packing Co.**, Palmyra, N.Y. The new department will be responsible for processing technical inquiries, testing specific products for specific operating conditions, editing technical bulletins, product development and testing, and handling customers' specific technical and mechanical requirements.

H. Russell Spielman, with the firm since 1944, now manager of the Technical Service Dept. of **Witco Chemical Co.** The department is responsible for technical service on Witco's line of chemicals, except carbon blacks. Headquartered in Chicago and with supplemental laboratories in Brooklyn and Los Angeles, members of the department also conduct experimental work in customers' plants and labs.

A. J. De Matteo, with the company since 1944, now general manager of **Watson-Stillman Press Div., Farrel-Birmingham Co., Inc.**, Roselle, N.J.

A. W. Sokolowski named vice president of engineering of **The Lanly Co.**, Cleveland, Ohio, maker of industrial heat processing equipment, including ovens, dryers, and low-temperature furnaces.

George M. Hale, formerly general sales manager, now vice president-sales of **Canadian Resins and Chemicals, Ltd.**, Montreal, Que.

George R. Williams appointed sales representative in the New York City area for the Organic Chemical Sales Dept. of **Emery Industries, Inc.**, Cincinnati, Ohio. He will handle dibasic acids, polymerized acids, plasticizers, fatty esters, lubricant esters, and textile finishing oils and softeners.

Dr. Francis M. Parker, formerly marketing director of Merck & Co.'s Chemical Div., named to the newly created position of director of marketing for **American Viscose Corp.**, Philadelphia, Pa.

J. D. Couig, formerly with the Chemical Div. of Celanese Corp. of America, now with the Chicago office of **J. P. Stevens & Co., Inc.** He will be concerned with the sale of industrial fibrous glass fabrics.

Martin Rosen named technical director of **Kaye-Tex Mfg. Corp.**, Yardville, N.J., producers of plastic sheeting. He will also be responsible for the direction of technical

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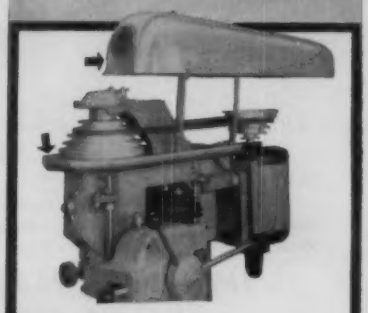

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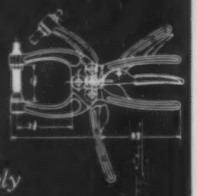
Trigger-Release levers also available on DE-STA-CO Toggle Clamp Models 461, 462-S, 463, and 463-S (jaw spans ranging from ½" to 3").



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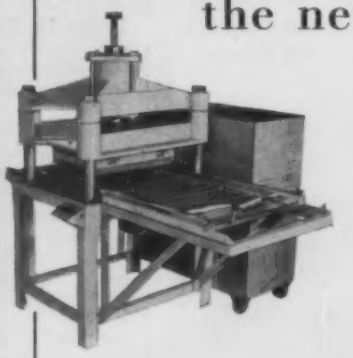

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France, Paris	Loiret and Haentjens††
Holland, The Hague	Handelsmaatschappij Vos & Co.††
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Companies... People

activities of the firm's wholly owned subsidiary, **Kaykor Industries, Inc.**, manufacturer of vinyl and other structural and lining materials for corrosion-resistant construction.

John W. Reid resigned as vice president of **Brown-Allen Chemicals, Inc.**

Dewey H. Nelson, formerly assistant to the sales manager, promoted to sales manager of **Becco Chemical Div., Food Machinery & Chemical Corp.**, Buffalo, N.Y., succeeding the late **John F. Shea.**

Robert Paul Blaine, formerly technical service manager of B. F. Goodrich Chemical Co., now manager of international sales for **Goodrich-Gulf Chemicals, Inc.**

Charles W. Boyle, named construction manager of **Plasteel Products Corp.**, will be in charge of installations nationally of Plasteel products, which include Plasteelite translucent reinforced plastics panels, protected metal roofing, siding, roof deck, and insulated panels.

Leo L. Bromley named technical director of **Cellofilm Industries, Inc.**, Woodbridge, N.J., producer of nitrocellulose base solutions.

Robert T. Baliff, formerly customer service assistant, named sales promotion manager of **L.O.F. Glass Fibers Co.** His responsibilities will include trade shows and exhibits, publicity, sales meetings, and coordinating public relations activities.

G. Wayne Hanna appointed special sales representative of the **Plastics Div. of Dominion Gasket & Mfg. Co. Ltd.**, Ont., and will handle the firm's line of Dom-X polyethylene, rigid PVC, and other thermoplastic pipe and fittings.

Thomas F. Long named vice president in charge of sales of **Alpha Plastics, Inc.**, Livingston, N.J., maker of rigid, unplasticized polyvinyl chloride pipe and tubing.

Robert E. Blackmore appointed technical sales representative of **Rubber & Asbestos Corp.**, with headquarters in Berwyn, Ill.

Ben Milt appointed sales manager of **Jensen Specialties, Inc.**, manufacturer of industrial ovens, infrared equipment, conveyors, etc.

George F. Pryor elected a member of the board of directors of **Sun Rubber Co.**, Barberton, Ohio, to fill the unexpired term of the late **Joseph L. McLane.**

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FOR SALE: 4 Stokes preform presses, 280C, 294, R and T; 1 Stokes standard 150 ton molding press; 5 self-contained lab presses, 10, 30 and 50 tons; 1 MPM 1¼" electric extruder; 5 Cumberland #½ cutters, 3 HP; also mills, mixers, slitters, etc., Chemical and Process Machinery Corp., 52 Ninth Street, Brooklyn 15, N.Y., phone HYacinth 9-7200.

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FOR SALE: 2000 Ton WS press 46"x60" Max. DLO 35" with 14" stroke. (2) 500 Ton, Lake Erie, 40x72, Ram 18"x18" stroke. (1) HPM 200 ton Smooth-line Molding press 25"x24" Late type, fast traverse with all controls. Power units in stock & other Hydraulic presses. List your surplus with us. Hydraulics Industrial, 2020 Renfrew, Elmont, N.Y.

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Lester type L-2-8 Injection Molding Machine, 8 oz. capacity, complete with instruments. Excellent running condition, immediate delivery. Can be seen in operation.
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1140 Commerce Avenue
Union, New Jersey

FOR SALE: Second hand Carver Laboratory Press—50 ton 12"x12" Laboratory Press—1"x18" 300 psi accumulator—6"x12" laboratory plastic Mill—condition excellent. Reply Box 1902, Modern Plastics.

NEW ARRIVALS FOR SALE: French Oil Mill Mchy. Compression Molding Presses; 75-170 tons, 3-170 tons, 35"x18", 5-95 tons 29"x18", 3-75 tons 18"x17", 5 Preheaters 2 KW, Wood 20"x20" 12" ram 170 tons; Southwark 24"x24" 12" ram. 170 tons; Baldwin Southwark 4-26"x26" 8" rams, 75 tons; 5-26"x26" 7" rams 57.7 tons; 2-15"x15" 8" rams 75 tons; 2-19"x24" 10" rams, 78 tons; 2-12"x12" 7½" rams 66 tons; 2-D&B 12"x12" 7" rams, 57.7 tons; 8"x9" 4½" rams, 24 tons; D&B 12"x12" 3" rams, 10 tons; HPM Transfer Molding 75 tons; Preform Presses, Colton 5½T Stokes R and DDS-2MD; New Universal Dual Pumping Units 3-15 HP; Lab. Mills and Calenders; also Extruders, Mixers, Vulcanizers, Injection Molding Units, etc. Universal Hydraulic Machinery Co., Inc., 285 Hudson St., New York 13.

FOR SALE: Injection Molding Machine, 1954 Lewis No. 6 with oversize cylinder. 8 ounce capacity. Like new, $10,500. Pyramid Products Co. Inc., 3967 E. 93, Cleveland 5, O.

FOR SALE: 1—Lester 6 oz. 1947. 1—Lester 6 oz. 1942.—1—Watson Stillman 8 oz. 1942.—1—Glengary Weigh Feeder. All above in good working condition. Can be seen in operation. Contact: Mr. J. Charzewski, Garray Plastics Co., Inc., 333 Bergen Ave., Kearny, N.J.

FOR SALE: Two 2½" NRM Extruders—Excellent Condition. Reply Box 1912, Modern Plastics.

FOR SALE: 2000 ton W-S Press, 12" ram stroke, steam platens 60"x46", with Vickers Pumps—one French Oil Mill 200 ton self-contained Press, 48"x72" platens —Injection Machines 6 to 20 oz.—50 ton 12"x12" Molding Presses—¾" double solenoid and cam operating valves,—Carver laboratory presses—6"x12" laboratory mills. Plastic Machinery Exchange, 426 Essex Ave., Boonton, N. J., Telephone DE 4-1615.

THROPP LABORATORY CALENDER
Vertical calender for sheeting PVC film. 3 stainless steel rolls, 15"x6", adjustable speed control, spur gear drive to General Electric 5/7½ hp. dc motor type-CD, 575/1750-rpm, thiymotrol push button control, General Electric control panel, with relay switches, 1 Trumbull type-RBA, 60-amp., 3-pole safety switch.
Reply Box 1910, Modern Plastics.

FOR SALE: 800 ton laminating press with 23 openings 26"x38". 300 ton laminating press with 10 openings 40"x40". 300 ton upstroke press 22"x35" platens. Farrel 200 ton 30"x30" platens. 200 ton Hobbing Press 18"x14" platens. D & B 140 ton, 36"x36" platens. D & B 150 tons, 24"x24" platens. Adamson 80 ton, 20"x20" platens. Farrel 200-ton 20"x80" platens. French Oil 120 ton self-contained 18"x22" platens. W. S. 40 ton self-contained with 12"x12" elect. heated platens. Also Lab. to 2,000 tons from 12"x12" to 48"x48". Hydr. Pumps and accumulators. Stokes Automatic Molding presses. Van Dorn 1 oz. Injection Molding Machine. Stokes R, 2½", single punch, Preform Machine, Kux 2½" dia., single punch Preform Machine. Mills and Calenders up to 84". New Seco 6"x13" and 8"x16" Lab. Mixing Mills and Calenders. Hartig 3¼" Plastic Extruder. Plastic and Rubber Extruders. Oxford 57" Slitter. Rotary and single punch Preform Machines, ½" to 4" Injection Molding Machines 1 oz. to 60 oz. Baker-Perkins & J. H. Day Jacketed Mixers. Plastic Grinders. Gas Boilers. Partial listing. We buy your surplus machinery. Stein Equipment Co., 107—8th Street, Brooklyn 15, New York. Sterling 8-1944.

FOR SALE: Vacuum Metallizer 36". Continuous Process Extruding, Vacforming Blanking op. on 4½" Extruder. Injection Presses: 8, 24 oz. Reed. 4,9,16 oz HPM, 6,8,12 oz Lester, 8 oz vertical Giddings & Lewis, 4 oz Lewis, 1 oz Van Dorn. For extruder: 30" Sheet Die, 52" Pull-Off, 48" Sheet Stacker. 14" & 6" Dulmage Meter. Pumps. Conveyors. Despatch 48x72" Sheet Preheat Oven. Apex 2 color Container Imprinter. Scrapgrinders. Compression & Transfer presses 50 to 600 T.—Elmes Hydrolairpress 30 T. 2 & 5 KW Electronic Preheaters. Stokes No T Preformpress. Several Vacuum Form. Mach. 1,000 lbs. Paterson Conical Mixers—All Midwest locations. List your Surplus equip. with me. Justin Zenner, 823 Waveland Ave., Chicago 13, Ill.

FOR SALE: Available to press manufacturers for manufacture on a royalty basis —a self contained Injection Molding Conversion Device for use in conventional vertical hydraulic presses—a readily saleable item—covered by USA and foreign patents—demonstration model available—reply to Patent Attorney, 300 Main Street, Chatham, N. J.

FOR SALE: One #1—2" Hartig Extruder complete with 7½ H.P. U. S. Varidrive—Controls—Hopper—etc. A & L Mfg. Co., 9 Florence St., Bklyn, N.Y. EVergreen 8-9256.

(*Continued on page 332*)

GLIDPOL POLYESTER RESINS

...for lightweight, corrosion-free truck panels and bodies!

You, as a fabricator, may find new markets for your production in these applications.

Increased payload, low maintenance and versatility are vitally important to truck fleet operators. That's why they particularly like the double-duty flat bed which can be converted into a package carrier with stake or body panels. Conversion's even simpler now with these new fibrous glass panels, reinforced with GLIDPOL* polyester resins.

Extremely lightweight, these panels can be erected by one man in the time previously required for two men. These strong weather-resistant panels need little maintenance, won't rust, rot or corrode. Pigmented GEL-KOTE* coatings provide a smooth, splinter-free surface plus permanent, fade-proof color. Versatile GLIDPOL and GEL-KOTE resins are also used in the production of complete bodies for refrigerated delivery vans, tank wagons, other vehicles.

*A Glidden Trade-Mark

A request on your company letterhead will bring you a copy of Technical Bulletin MP-357 which fully describes all of the Glidden GLIDPOL resins for casting, laminating, molding and coating.

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POLYESTER RESINS
QUALITY Glidden PRODUCTS

THE GLIDDEN COMPANY • INDUSTRIAL FINISHES DIVISION • 900 UNION COMMERCE BLDG., CLEVELAND 14, O.
San Francisco • Los Angeles • Chicago (Nubian Division—1855 N. Leclaire Ave.) • Minneapolis • St. Louis • New Orleans • Cleveland • Atlanta • Reading, Canada: Toronto and Montreal

(Continued from page 330)

JUST PURCHASED!

Cutters, Rotary, Plastic
Ball & Jewell #2 with 40 HP MD, Extra Knives

Extruders
Hartig 2" Elec. Htd., 7½ HP Reliance V-S Drive 98% New
MPM 3½" New 1955, With Sheeting Dies & Takeup Rolls
Hartig 3½" Elec. Htd., 45" Barrel, 20 HP Reliance V-S Drive

Injection Molding Machines
2 Oz. Van Dorn, Oversize Cylinder, Model H-200
6 Oz. Watson-Stillman with 2 Wheelco Controls
16 Oz. Reed-Prentice No. 10-E-16, Elec. Htd., 1948

Mills, Rubber/Plastic
18" x 50" Farrel, Rubber/Plastic

Presses, Molding
15 Ton Baker Fully Automatic
15 Ton, Stokes No. 200 D-2 Automatic (10)
15 Ton Stokes 200 D-3
25 Ton Dunning & Boschert Elec. Htd. 16" x 16" Platen, 12" DLO
30 Ton, Baker Full Automatic Model 958, Excellent Condition, New 1951
40 Ton, Francis 4 Opening, 12" x 12" Elec. Heated Platens
50 Ton, Stokes, Semi-Auto., Self. Cont.
100 Ton Stokes Standard Semi-Automatic Power System Timing Controls
100 Ton, Lake Erie Hi-Speed, 24" x 24" Bed, 12" DLO, Self. Cont.
113 Ton French Oil Mill 6 Opening, Elec. Htd. Platens 15" x 18"
113 Ton R.D. Wood 5-Opening Elec. Htd. Platens 14" x 20"
113 Ton Stewart Bolling 20" x 20" Steam Platens 12" Upmoving Ram x 14" STR
150 Ton Stokes Standard Semi-Automatic Power System Timing Controls
175 Ton Viceroy Slab-Side 24" x 24" Elec. Htd. Platen with Hand Pump
200 Ton Stokes Semi-Automatic Power System Timing Controls
225 Ton Farrel 14" Ram x 18" Stroke L-R 26½" x F-B 24½" 7½ HP MD
300 Ton Stokes Semi-Automatic Power System Timing Controls
625 Ton, Farrel, Steam Platens 52" x 52", Pump, Mtr., Controls, Under Power
669 Ton, Moiane, 3 Upmoving Rams, 16" Stroke
1200 Ton, HPM, 15 Openings, 100" x 120" Steam Platens, Self-Cont. (2)
4000 Ton Mesta 3 Upmoving 30" Rams x 20" Str. Bed 34" x 351"

Furnaces and Ovens
Megatherm, 3/60/220, 5 EN, 2-3 lb. Phenolic Per Min. (8)
Despatch Mdl. Diaz-7583, 3 Drawers, 17" x 17" x 5" (2)
Despatch Mdl. P1hd-8 8 Drawers, 12 x 18 x 2½" (2)

Tablet Machines
Model R Stokes, Single Punch, Variable Speed Motor Drive, 3 HP
No. RB-2 Stokes, 16 Station, Motor Drive, 2 HP
Model 45 Defiance, 200 Ton, 15 HP, Vari-Speed, MD
Model F, Stokes, Single Punch, MD
No. 5 Arthur Colton, Motor Drive, 3 HP
No. DDS-2 Stokes, 23 Stations, US Vari-Drive, 10 HP
Model T Stokes Hydraulic Equalizer MD

Mixers
No. 3A Banbury, 150 HP Md Rubber/Plastic
No. 3 Banbury 75 HP MD Excellent Condition Slide Door Construction.
80 Qt. Read Vertical 3 Speed 1 HP MD
1000# J. H. Day Size D-10 Jacketed Ribbon Blender

Calenders
24" x 48" Farrel-Birmingham, 3 Roll, 50 HP DC Motor
9" x 48" American Tool 4 Roll Doubling Belt Drive

Paint/Ink Mills
5" x 12" 3 Roll J. H. Day Lab Mill

Pelletizers
Mitts & Merrill Model 10-N-6 15 HP V.S. Drive

Make Us Your Prime Source for All Types of Plastics Machinery
Hydraulic Presses from lab size to 5,000 ton
Injection Molders from ¼ oz. to 60 oz. size
Extruders from lab size to 12"
Plastic & Rubber Mills and Calenders up to 84" size
Tablet Preform Presses single punch and rotary, all sizes
Mixers all sizes, types and capacities

Also a complete selection of tumbling barrels, take-up equipment, hydraulic power units, pumps, ovens, blenders, scrap cutters, pelletizers, coating equipment and laminating equipment.

JOHNSON MACHINERY Co.
683-P Frelinghuysen Ave., Newark, N.J.
What Do You Need? What Have You to Sell?

FOR SALE: 64 Oz. Injection Molding Machine with Pre-Plasticiser. 750 Ton Clamp. Mold Size 32" vertical, 50" horizontal. 8 & 4 oz. Injection Molders. Aaron Machinery Co. Inc., 45 Crosby St., New York 12, N. Y. tel.: WAlker 5-8300.

FOR SALE: 1—6"x12" Laboratory Mill, m.d.; 1—Ball & Jewell Rotary Cutter, size 0 m.d.; 4—Horizontal Dry Powder ribbon Mixers, 2000#, 1500#, 800#, 500#; 1—Pfaudler 300 gal. G.L. Jack. Agt. Reactor; 1—New 3 Roll 6"x16" Laboratory Calender; 1—Day 15 Gal. Pony Mixer. S.S. Cans, m.d.; 1—Day Imperial #30 Mixer, 75 gal.; 1—Mikro Pulverizer #2th, with motor; 4—Reed-Prentice & W-S Injection Molding Machines, 2-16 oz.; Also other sizes: Hydraulic Presses, Tubers, Banbury Mixers, Mills, Vulcanizers, Calenders, Pellet Presses, Cutters. Send us your inquiries. What have you for sale? Consolidated Products Co., Inc., 50 Bloomfield Street, Hoboken, N. J. HOboken 3-4425, N.Y. Tel.: BArclay 7-0600.

FOR SALE: #9 Standard 4 Rod Compound Up Acting Geared Toggle Press 200 T. cap; 24x24" platens; w/roll feed, excellent, $2750. Waterbury Farrel 50 Ton Hydraulic Press; 4 post 30" x 16" table; bed 50x33"; 20" stroke; in good condition, $995. W. Stillman 50 T. Automatic Transfer Press, new '44, 11" dia. ram 12" stroke, 12x18" platen, $15000 cost new, $2975. W. Stillman 2000 T. Self-cont'd Press: arranged for 1500 tons 36" ram, str 12"; platen 48x60x3½" w/Vickers Pump, $14,950. Eveready: Box 638; Bridgeport, Connecticut, EDison 4-9471-2.

FOR SALE: 2—Baker Perkins 316 SS, 100 and 50 gal. jacketed, double arm Mixers; 6—Day 250 and 100 gal. double arm Mixers; 1—Robinson 90 cu. ft., 316 SS Powder Mixer; 2—Two Roll Mills 6"x12"; 8—Stokes Model DD2, DS3, D3 and B2 Rotary Preform Presses; 1—Stokes #294 single punch Preform Press; 4—Stokes Model "R" single punch Preform Presses; 1—Kux Model 15-25 Rotary Preform Press; Also: Sifters, Banbury Mixers, Powder Mixers, etc., partial listing; write for details; we purchase your surplus equipment; Brill Equipment Co., 2407 Third Ave., New York 51, N.Y.

FOR SALE: Marco Process consisting of Homogenizer, Roto-feed Mixers, Reactors, Kombinators and pumps all stainless steel. Also Sigma Blade jacketed Mixers, Pellet Presses, Mikro Pulverizers, Fitzpatrick Comminuting Machines, etc. We Buy Surplus Equipment. Perry Equipment Corp., 1429 N. 6th St., Phila. 22, Pa.

FOR SALE: 1—Model 50-30 Vacform Machine Complete Including Shear Cut Off and Roll Feed Attachment; 1—Model 88 (18 x 18) Vacform Machine; 1—50 Ton Dake Hydraulic Die Press, Model 27-125, Size Between Posts 26 by 54, 16" Daylight, Ram Speed 42-110. All Machines Very Slightly Used—Like New. Contact Indianapolis Paper Container Corporation, 217 West 10th Street, Indianapolis, Indiana.

FOR SALE: (6) new 100 ton, 10" ram, 10" stroke @$1250; (7) 200 ton. 9" stroke, 14" ram, 36x36, @ $2150; (6) 200 ton, 9" stroke, 15" ram, 30x30 @ $1850; (1) 50 ton complete, 18x18 @ $1850; (1) 200 ton 16" ram, 30x30 @ $2450; (2) 200 ton 16" ram, 42x42 @ $2850; (1) 200 ton, 15" ram, 42x42 @ $2600; (3) 250 ton (2) 12" ram, 30x60 rebuilt @ $3675. Hydraulic Sal-Press Co., Inc., 386-90 Warren Street, Bklyn, N.Y.

FOR SALE: 300 Ton W. S. Self Contained Compression, Mold 33½ x 27" x 18" stroke. Watson-Stillman—300 ton 20" x 20"—250 Ton. 28" x 24"—140 Ton 22" x 16". Waterbury-Farrel 85 Ton 20" x 24"—80 Ton 24" x 24". 63 Ton 15" x 15" with Pull Back Cyl. Lab Presses 10 & 15 Ton, platens 6" x 6" or 10" x 10". Many others. Accumulators, Valves, Pumps. Aaron Machinery Co. Inc., 45 Crosby St., New York 12, N.Y. Tel.: WAlker 5-8300.

VACUUM FORMING MACHINE: Two tables, each 30"x60" with Industrial Radiant Heat Co. heater. Brown Heat Controls, Timers, 5 HP vacuum pump. Used 3 months. Worth $10,000 new. Will sacrifice for cash. Reply Box 1919, Modern Plastics.

Machinery and equipment wanted

WANTED: Good used 200-300 ton compression press, must be self-contained and straight-ram type (not toggle type) and preferably though not necessarily, with transfer molding attachments. Send specifications and price to Box 1920, Modern Plastics.

WANTED: Original Reed Prentice 10D 8 Ounce Heating Cylinders in good condition manufactured in 1948 to 1952. Reply Box 1924, Modern Plastics.

Materials for sale

PLASTICIZERS: Standard quality, very low price. 20,000 lbs. DIOP, 10,000 lbs. DOP, also Tricresyl Phosphate, Acetyl Tributyl Citrate, Tributyl Citrate, occasionally Dibutyl & other Phthalates. Let us know your requirements. Chemical Affiliates, Inc., 274 Madison Ave., New York 16, N.Y. Tel.: MU. 3-2593.

Materials wanted

WANTED.
Polyethylene scrap, medium molecular weight, any color or mixed colors, melt index 1.5 to 2.5 preferred. We are a converter and pay higher prices than any dealer. Will contract for regular supply.
Reply Box 1909, Modern Plastics.

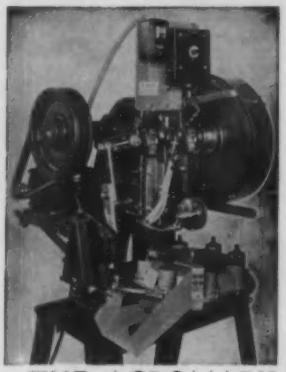
YOUR BEST MARKET for Surplus Molding Powders and Scrap Plastics—Gem City Trading. Contact Gem City for best prices on polyethylene, styrene, nylon, butyrate and acetate.
Gem City Trading—P. O. Box 941
Dayton 1, Ohio—HEmlock 2121

WANTED.
Vinyl, polyethylene and styrene scrap for our manufacture of molding and extrusion compounds. We can use rigid from vacuum forming, lumps, bleeder, slabs, trimmings, rejects—anything suitable for reprocessing. Send samples and details or telephone. Steady buyers since 1940.
Rotex Rubber Company, Inc.
1-23 Jabez Street, Newark 5, N.J.
MArket 4-4444

WANTED: Plexiglas and Lucite scrap, salvage and cut-offs, any quantity. Turn your surplus sheet stock into cash. Ask for our quotation. Duke Plastics Corp., 584 Broadway, B'klyn 6, N. Y. EVergreen 8-5520.

Do you have acrylic scrap in any shape or form? It will pay you to check our prices before selling elsewhere. We also buy any other type of plastic scrap, surplus materials and rejects.
Claude P. Bamberger, Inc.
One Mount Vernon St., Ridgefield Park, New Jersey.
Tel.: HUbbard 9-5330.
Not connected with any other firm of similar name

(Continued on page 334)



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thermosetting
and thermoplastic
PARTS and
PRODUCTS
in color

THE ACROMARK No. 2AH DIAL FEED HOT STAMPING MACHINE

provides a positive and widely adaptable semi-automatic unit for high production marking of parts and products that require trade-marking, lettering, design or number marking. ACROLEAF is used with fully controlled internal heating elements.

Send samples of product or blueprints today for estimate and literature.

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NEW DESIGN AND CONSTRUCTION

Custom Multiframe Hydraulic Presses

The Custom Multiframe is completely new—rugged, simple—with many exclusive features. No questionable castings. Send for quotation to your exact specifications for any purpose.

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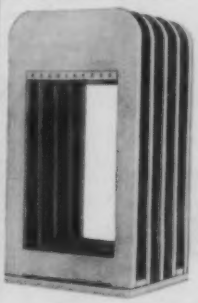
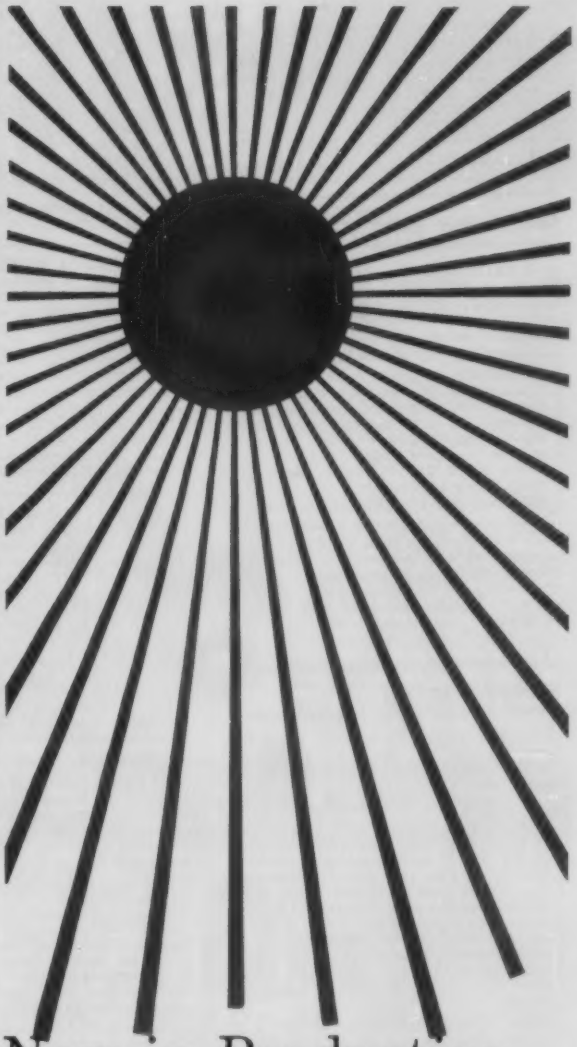
Patent Pending



Rolled steel frame from solid plates provides extreme rigidity and strength.



Now in Production

MERCURY RED TONERS

•

MERCURY RED LITHOPONES

WRITE FOR SAMPLES

Kentucky Color

Louisville 12, Kentucky

(*Continued from page 332*)

WANTED.
Plastics Scrap and Rejects of all kinds. Ground and unground. Also rejected molded pieces and surplus virgin molding powders. Top prices paid.
Reply Box 1922, Modern Plastics.

Molds for sale

FOR SALE: Complete line of Houseware Molds, Comb Molds, also some novelty and specialty items. No reasonable offer refused. Send for list. Reply Box 1921, Modern Plastics.

INJECTION MOLDING DIE.
Trade mark etc. for inter-nationally famous Dot's Dryers. These plastic gadgets are a permanent staple for drying hose, lingerie, diapers etc. on shower or towel bars in home or hotel. Mold in 1st class condition. Dot's Stocking Dryer Co.
837 Traction Ave., Los Angeles, Calif.

FOR SALE: Poppit Bead Mold—Injection—12MM—56 cavities—Perfect Condition. Earring Mold—Injection—Poppit Type—Containing 32 cavities—23MM and 16 cavities—19MM. Reply Box 1905, Modern Plastics.

Molds wanted

WANTED: Molds for novelty parts for home, desk or car. Send information to Fortune Laboratories, 1405 Main Street, Des Moines, Iowa.

WANTED.
A long established and very experienced firm of British Injection Molders would like the use of Molds of fast selling lines on Royalty basis for British and European markets. Advertisers operate modern plant (principally 10D Reed-Prentice) with excellent sales connections in consumer and industrial fields. First class credentials; paid-up capital ¾' million dollars.
Reply Box 1913, Modern Plastics

WANTED TO BUY.
An a No. 1 Water Pistol Mold to be run in 8-oz Reed. Send Samples and Price. Reply Box 1901, Modern Plastics.

MOLDS WANTED: We are interested in purchasing outright or on a royalty basis injection molds in good condition that can be used for the manufacturing of advertising specialties, premiums, give aways or small toys whose appearance would be enhanced by vacuum metallizing. Send samples of items, size of mold, prices and information to Metallized Products, Inc., 60 Agnes Street, Providence, R. I.

Help wanted

PLASTISOL COMPOUNDING: Wanted—Young married man thoroughly familiar with all phases of Plastisol compounding for responsible position with growing firm. Good working conditions. Should have some chemical background although degree not required. Write giving qualifications, salary expected and availability. Reply Box 1925, Modern Plastics.

CHEMIST.
Thoroughly experienced in manufacturing vinyl printing inks for film and sheeting. Excellent salary. Permanent position. Reply Box 1929, Modern Plastics.

PHYSICIST—PHYSICAL CHEMIST.
Multi-plant package manufacturer requires services of an applied research specialist with several years experience in the field of high polymer rheology (plastics, films, cellulose products). Person will assist to plan and carry out an interesting program relating physical properties of materials to converting and end use performance. Modern laboratories and equipment in pleasant surroundings. Prefer M.S. degree, but will consider B.S.
Please send detailed resume to Box 1934, Modern Plastics.

COMMERCIAL DEVELOPMENT.
Richardson, a leading molder, laminator, fabricator of plastic and rubber products, is seeking experienced men for newly formed Commercial Development Team. Especially, seeking man with strong technical knowledge of molding materials and methods, coupled with market research experience or aptitude. An interesting situation for the right man. Please reply to: Vice President of Industrial Relations, The Richardson Company, 2700 Lake Street, Melrose Park, Illinois.

EXTRUSION SUPERINTENDENT: Assistant Superintendent, Shift Foreman, Compounder, and Die Makers needed for new extrusion plant. Clear and overlay hose and profiles. Full time or on consultant basis. Top wages commensurate with knowledge and experience. Inquiries held absolutely confidential. We are not your present employer. We are just starting. Write only if completely experienced in compounding or running vinyl clear and overlay hose from virgin and reprocessed material. Address: Extrusion Products Company, Attention: M. A. Mark, P. O. Box 684, Lowell, Mass.

WANTED—PRODUCTION ENGINEER: Must have engineering education and experience in plastics, capable of general supervision of industrial engineering, estimates, secondary tooling and plant problems. Will be responsible for the designing and building of all secondary equipment. The layout of the above mentioned equipment will be required of the individual we would employ. Plant does custom and proprietary compression and injection molding. Company over 25 years in plastics, and still expanding. Give complete resume of education, experience and past earnings. Reply Box 1900, Modern Plastics.

PLASTICS RESEARCH AND DEVELOPMENT.
Leading Chemical and Plastics manufacturing company in Delaware Valley area seeks a young enterprising chemist, physicist, or engineer for physics laboratory, stimulating research and development program on physical properties of materials, primarily plastics for use in aircraft, architecture, automotive applications, etc. Write full details of training, general background and salary expected to:
Rohm & Haas Co.
Department O.T.E.-1
5000 Richmond Street
Philadelphia 37, Pa.
Replies will be acknowledged and treated in confidence.

RESIN CHEMIST.
For research position with promising opportunities. Involves research on wide range of surface coating resins to be applied by newly-developed solventless technique. Desirable experience and education as follows: 3 to 5 years minimum experience in broad field of resins involving co-polymerization, catalysis and plastization. Should have a B.S. in Chemistry or Chemical Engineering. Courses in polymer chemistry desirable but not necessary. Reply Box 1916, Modern Plastics, describing in detail education and research experience in resin field.

CHEMISTS, ENGINEERS, Tool Men, and Methods Men, preferably experienced in the reinforced plastics field. Young and rapidly expanding manufacturer in midwest. Excellent opportunities. Applications will be kept confidential. Reply: The Glastic Corporation, 4321 Glenridge Road, Cleveland 21, Ohio.

EXTRUSION SPECIALIST: Man with knowledge of all phases of the extrusion field, including machine set-up, die design, ability to handle people. Reply Box 1928, Modern Plastics.

PLASTICS SALESMAN.
Highly respected, soundly financed manufacturer of reinforced plastic materials has opening for Midwest representative. Applicants should have knowledge of injection molding and applications. Unlimited opportunity for the right man in a new and practically noncompetitive field. Send resume. Interviews will be arranged. Reply Box 1927, Modern Plastics.

PLASTICS ENGINEER OR MECHANICAL ENGINEER interested in plastics: Excellent opportunity in Southeastern U.S. with well-established company that has recently branched into plastic injection molding and extrusion. Responsibility includes design, alteration and repair of injection molds, and design and cost estimates of new plastic products. Experience desired but not absolutely essential. Replies held in strict confidence. Salary open and excellent fringe benefits provided. Send replies to:
Mr. D. A. Bramlett, Personnel Director
Sonoco Products Company
Hartsville, S.C.

WANTED: Young engineer with some plastics experience (preferably in packaging or reinforced polyester) who wants broader fields: to do research and development work with independent plastics laboratory. Duties will include product studies, development work, testing and report writing. Reply Box 1908, Modern Plastics.

MOLDING TECHNICIAN: Nationally known manufacturer, located in Southern Wisconsin, has permanent position for Molding Technician experienced in all phases of injection molding. Excellent salary, bonus, insurance, and retirement benefits. Give complete resume in first letter. All replies confidential. Reply Box 1938, Modern Plastics.

EXTRUSION FOREMAN: Thoroughly experienced in Polyethylene and Vinyl extrusions. Good opportunity for advancement with growing young organization. Give details of experience and starting salary required. Commonwealth Pipe & Tubing, Inc., 125 So. 2nd St., Phila. 6, Pa.

ASSISTANT SUPERINTENDENT FABRICATIONS: One of America's oldest and leading fabricators, vacuum and plug and ring forming of all types sheets, rods and tubes, has opening for top man with varied experience in the above plastic work. Applicant must have top reputation and references for ability, aggressiveness, initiative and ambition. We produce for national distribution to industry. This is not a desk job, but the pay is tops. The location is the finest and the opportunity is the best for a man who is now at a stalemate in his job. All replies confidential. The position will remain open until we find the right man. Send complete information to Gladwin Plastics, Inc., 169 Courtland Street N. E., Atlanta, Georgia.

PRODUCTION FOREMAN: Man to take charge of small proprietary Injection molding department with 3 machines. Must be able to maintain machinery, make mold changes, and assume full responsibility for department personnel. New York City Location. Reply Box 1926, Modern Plastics.

(*Continued on page 336*)

CHEMICAL ENGINEER
for REPUBLIC AVIATION

. . . for manufacturing research and process development work in aircraft nonmetallics. Must have experience in reinforced plastics, design and tooling. Knowledge of polyesters, epoxy, and phenolic resins is necessary. Experience in aircraft sealants, coatings, chemical milling, metal cleaning and plating and specification writing helpful. Ability to carry assignments through development stage into production is essential.

Among other advantages, Republic offers a comprehensive employee benefit program including company paid hospitalization and surgical insurance, accident and life insurance, tuition (2/3), 2-fold pension plan, individual merit rated increases and many others.

Please send resume including details of technical background to:

Mr. Paul Hartman, Employment Department

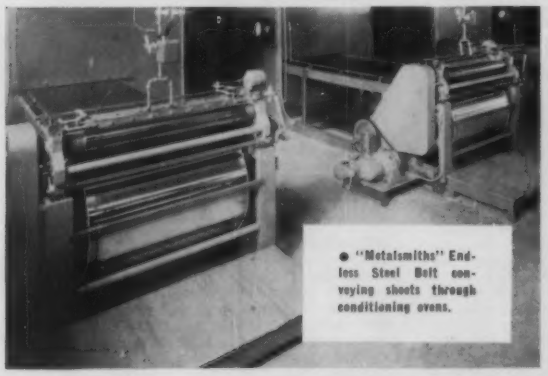
REPUBLIC AVIATION

Farmingdale, L.I., New York

Increase production—cut costs with

CONTINUOUS BELT PROCESSING

of sheets—film—coatings—laminated work, etc.



● "Metalsmiths" Endless Steel Belt conveying sheets through conditioning ovens.

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WEST COAST OR SOUTH: 20 years experience in injection molding covering sales engineering, estimating, design tooling and production supervision. Thoroughly capable. Some experience in compression molding. Desires position in warmer climate. Currently employed in the northeast. Reply Box 1915, Modern Plastics.

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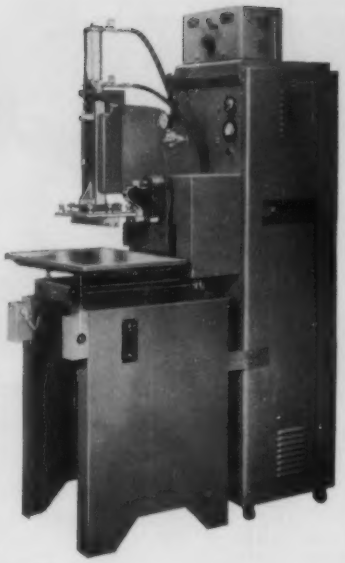

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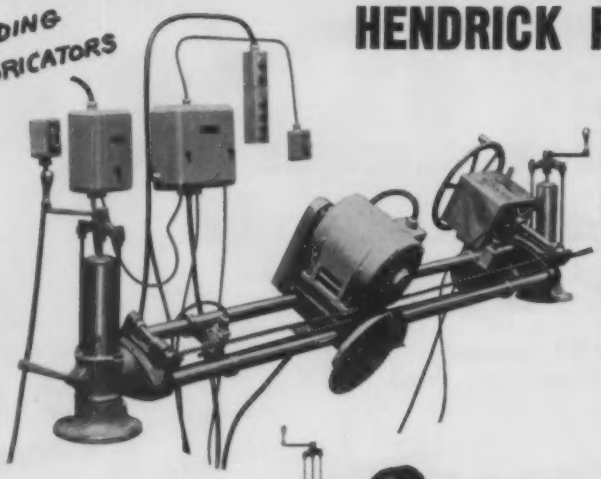

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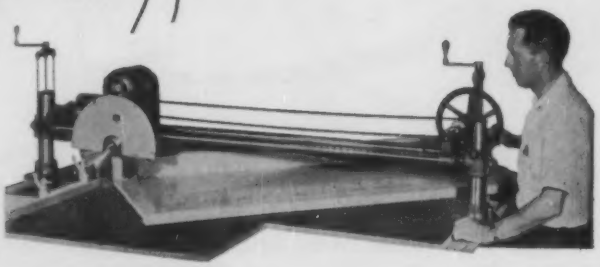

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Nine important charts summarize technical data on plastics films, adhesives, coatings, laminates, plasticizers and other vital topics. The plastics properties chart, perhaps the most referred-to section of the Encyclopedia, measures 45" x 28" and is suitable for wall mounting.

Most of the material in your copy of the Modern Plastics Encyclopedia Issue is *work* data—information which companies working with plastics can put to valuable use, day-in and day-out.

This 1,122-page volume gives complete coverage to such important subjects as the characteristics of plastics materials, and the employment of fillers for lowering the cost and increasing the strength of plastics parts. Plastics coatings and foamed plastics are discussed exhaustively, as are all important finishing and decorating methods. New cost-reducing slants on vacuum forming, deep drawing, injection molding, extruding, and other production techniques are explained, too.

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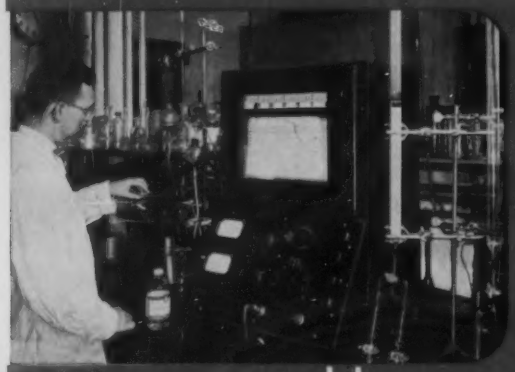

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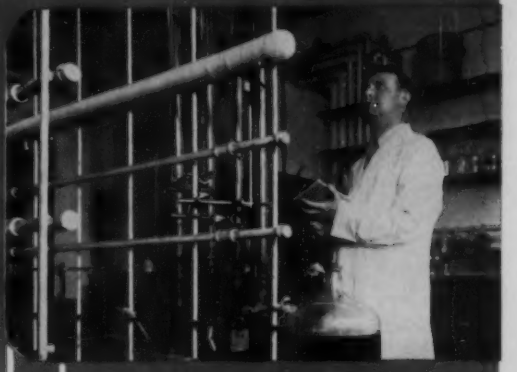

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